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# GeoScience Abstracts

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Alberta, Dept. of Mines and Minerals, Annual Report. Edmonton, Alberta.
American Association of Petroleum Geologists, Bulletin. Tulsa, Oklahoma.
American Journal of Science. New Haven, Connecticut.
American Mineralogist (Mineralogical Society of America). Ann Arbor, Michigan.
American Scientist. Easton, Pennsylvania.
Bulletins of American Paleontology (Paleontological Research Institution). Ithaca, New York.
Cahiers de Géographie de Québec (Université Laval, Institut de Géographie). Quebec.
California, Division of Mines, [Map]. San Francisco.
California Institute of Technology, Division of Geological Sciences, Contribution. Pasadena, California.
California Journal of Mines and Geology (California, Division of Mines). San Francisco.
California, University (Los Angeles), Institute of Geophysics, Publication.
Canada, Dept. of Mines and Technical Surveys, Geographical Branch, Bibliographical Series; Paper. Ottawa.
Canada, Geological Survey, Bulletin; Economic Geology Series; Map; Memoir; Paper. Ottawa.
Canadian Geographer (Canadian Association of Geographers). Ottawa.
Canadian Mining and Metallurgical Bulletin. Montreal.
Canadian Mining Journal. Gardenvale, Quebec.
Civil Engineering. Easton, Pennsylvania.
Columbia University, Lamont Geological Observatory, Contribution. Palisades, New York.
Compass (Sigma Gamma Epsilon). Provo, Utah.
Cushman Foundation for Foraminiferal Research, Contribution. Ithaca, New York.
Deep-Sea Research. London-New York.
Delaware Geological Survey, Report of Investigations. Newark, Delaware.
Economic Geology (Society of Economic Geologists). Lancaster, Pennsylvania.
Engineering Journal. Montreal.
Geochimica et Cosmochimica Acta. London-New York.
Geographical Bulletin (Canada, Dept. of Mines and Technical Surveys, Geographical Branch). Ottawa.
Geological Association of Canada, Proceedings. Toronto.
Geological Society of America, Bulletin. New York.
Geophysics (Society of Exploration Geophysicists). Tulsa, Oklahoma.
Harvard University, Dept. of Mineralogy and Petrography, Contribution. Cambridge, Massachusetts.
Illinois, State Geological Survey, Bulletin; Circular. Urbana, Illinois.
Journal of Geophysical Research. Washington, D. C.
Journal of Paleontology. Tulsa, Oklahoma.
Journal of Petroleum Technology (Society of Petroleum Engineers). Dallas, Texas.
Journal of Sedimentary Petrology. Tulsa, Oklahoma.
Kansas, State Geological Survey, Bulletin. Lawrence, Kansas.
Kentucky Geological Survey, Report of Investigations; Special Publication. Lexington, Kentucky.
Lamont Geological Observatory, see under Columbia University.
Maine Geological Survey, Minerals Resources Index. Augusta, Maine.
Mines Magazine (Colorado School of Mines, Alumni Association). Denver, Colorado.
Mining Engineering (American Institute of Mining, Metallurgical and Petroleum Engineers). New York.
Mississippi State Geological Survey, Bulletin. University, Mississippi.
Moskovskoe Obshchestvo Ispytatelei Prirody, Byulleten, Otdel Geologicheskii. Moscow.
National Academy of Sciences-National Research Council, Publication. Washington, D.C.
New Mexico, State Engineer Office, Technical Report. Santa Fe, New Mexico.
Oklahoma Geological Survey, Bulletin; Oklahoma Geology Notes. Norman, Oklahoma.
Quebec (Province), Dept. of Mines, Geological Report; [Map]; Preliminary Report. Quebec.
Research Council of Alberta, Contribution. Edmonton, Alberta.
Science. Washington, D.C.
Scientific American. New York.
South Carolina, State Development Board, Division of Geology, Bulletin. Columbia, South Carolina.
South Dakota, State Geological Survey, Biennial Report. Vermillion, South Dakota.
Tennessee, Dept. of Conservation, Division of Geology, Information Circular; Report of Investigations. Nashville, Tennessee.
U.S. Geological Survey, Circular; Geologic Quadrangle Map; Geophysical Investigations Map; Mineral Investigations Map; Miscellaneous Investigations Map; Oil and Gas Investigations Map; Water-Supply Paper. Washington, D.C.
U.S. National Bureau of Standards, Journal of Research, Washington, D.C.
Woods Hole, Mass., Oceanographic Institution, Contribution.

# GeoScience Abstracts

## 1. GEOLOGIC MAPS, AREAL AND REGIONAL GEOLOGY

### PART I. GEOLOGIC MAPS

**1-292. Canada, Geological Survey. ALBERTA AND NORTHEASTERN BRITISH COLUMBIA, SHOWING OIL AND GAS FIELDS: Its: Map 1039A, 5th ed., scale 1:1,267,200, 1958.**

No geology is given but map shows the shape and position of all known oil and/or gas fields; new discoveries of oil and gas; pipe lines constructed, planned, and proposed; oil refineries; natural gas processing plants; and known distribution of bituminous sand. --H. M. A. Rice.

**1-293. Tremblay, L. P. URANIUM CITY, SASKATCHEWAN, SHEET 7: Canada, Geol. Survey, Map 12-1958, scale 1 in. to 800 ft., marginal notes, 1958.**

Preliminary series geological map and marginal notes of a small area underlain by Archaean and Proterozoic rocks immediately N. of Lake Athabasca. Earlier rocks are highly contorted gneisses and schists with a general northeasterly trend. These are cut by several E.-trending faults. Narrow pitchblende-bearing veins occur in the area both parallel with the foliation of the rocks and at right angles to it. On only one property, that of Beta Gamma Mines Ltd., has any amount of exploration been done. --H. M. A. Rice.

**1-294. Monroe, W. H., and J. L. Hunt. GEOLOGY OF THE EPES QUADRANGLE, ALABAMA: U. S. Geol. Survey, Geol. Quad. Map GQ-113, scale 1:62,500, contour interval 20 ft., lat. 32°30'-32° 45'N., long. 88°-88°15'W., 1958.**

The Epes quadrangle comprises an area of about 250 sq. mi. in Sunter and Greene counties, western Alabama. Rocks of late Cretaceous and early Tertiary age crop out in the area. The quadrangle was studied because of the unusual faulting and because of the need of petroleum geologists for accurately located outcrops from which samples may be collected for correlation purposes. Included are a geologic map, columnar and structure sections, and a brief text describing formations and structure. --U. S. Geol. Survey.

**1-295. Welch, Stewart W. STRATIGRAPHY OF UPPER MISSISSIPPIAN ROCKS ABOVE THE TUSCUMBIA LIMESTONE IN NORTHERN ALABAMA AND NORTHEASTERN MISSISSIPPI: U. S. Geol. Survey, Oil & Gas Inv. Map OC-58, 1958.**

Included are stratigraphic sections showing thickness, lithology, and lateral changes of the various rock units; an index map giving locations of the stratigraphic sections and outcrop area of Upper Mississippian rocks; a correlation chart of stratigraphic names; and a brief text describing the stratigraphy. --U. S. Geol. Survey.

**1-296. Condon, W. H., and J. T. Cass. MAP OF A PART OF PRINCE WILLIAM SOUND AREA, ALASKA, SHOWING LINEAR GEOLOGIC FEATURES AS SHOWN ON AERIAL PHOTOGRAPHS: U. S. Geol. Survey, Misc. Inv. Map I-273, scale 1:125,000, contour interval 200 ft., 1958.**

This black and white map, with accompanying brief text, shows the distribution of linear features in the Prince William Sound area that are believed to represent faults, shear zones, and joints. The linear features were interpreted entirely from vertical aerial photographs. Mines and prospects in the area are plotted on the map; it is believed that a relation may exist between mineral deposits and the linear features. --U. S. Geol. Survey.

**1-297. Karlstrom, Thor N. V. GROUND CONDITIONS AND SURFICIAL GEOLOGY OF THE KENAI-KASILOF AREA, KENAI PENINSULA, SOUTH-CENTRAL ALASKA: U. S. Geol. Survey, Misc. Inv. Map I-269, scale 1:63,360, contour interval 50 ft., 1958.**

The map shows the surficial geology of an area of about 200 sq. mi. marginal to Cook Inlet and between the villages of Kenai and Kasilof on the Kenai Peninsula. The area is part of a coastal lowland underlain by unconsolidated deposits largely of glacial origin. A brief text describes the geology, topography, vegetation, drainage, and ground conditions affecting land development. --U. S. Geol. Survey.

**1-298. Lathram, E. H., R. A. Loney, W. H. Condon, and H. C. Berg. PROGRESS MAP OF THE GEOLOGY OF THE JUNEAU QUADRANGLE, ALASKA: U. S. Geol. Survey, Misc. Inv. Map I-276, scale 1:250,000, lat. 58°-59°N., long. 134°-136°W., 1958.**

**1-299. Dibblee, Thomas W., Jr. GEOLOGIC MAP OF THE BORON QUADRANGLE, KERN AND SAN BERNARDINO COUNTIES, CALIF.: U. S. Geol. Survey, Mineral Inv. Map MF-204, scale 1:62,500, contour interval 20 ft., lat. 35°-35°15'N., long. 117°30'-117°45'W., 1958.**

**1-300. Jennings, Charles W., comp. GEOLOGIC MAP OF CALIFORNIA: DEATH VALLEY SHEET: California, Div. Mines, scale 1:250,000, contour intervals 100 and 200 ft., 2 sheets: geol. map, strat. nomenclature, 2 illus., 1958, 23 refs.**

The first sheet of the Olaf P. Jenkins edition of the geologic map of California covers the area 36°-37°N. 116°-118°W. It indicates in color the geology of the area of eastern California bounded by the state line on the E. and Owens Valley on the W., extending from about Sykes siding on the S. to Grapevine Ranger Station in Death Valley National Monument on the N.

The map shows units ranging in age from Precambrian to modern sand dunes. Sedimentary and metasedimentary rocks representing Precambrian, Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, Permian, Triassic, Tertiary, and Quaternary periods are indicated. Igneous rocks and their metamorphic equivalents range from Mesozoic to Pleistocene.

Accompanying the map is a sheet containing a chart and list of references showing the reports and maps used in compilation of the Death Valley sheet, a table of stratigraphic nomenclature, an index map showing the U. S. Geological Survey topographic maps covering the area, and 2 photographs. --From California, Div. Mines, Mineral Inf. Service, v. 12, no. 2, p. 16, Feb. 1959.

1-301. Boardman, R. L., L. R. Litsey, and H. E. Bowers. EXPLORATION FOR URANIUM-VANADIUM DEPOSITS BY THE U. S. GEOLOGICAL SURVEY IN THE CLUB MESA AREA, URAVAN DISTRICT, MONTROSE COUNTY, COLO.: U. S. Geol. Survey, Mineral Inv. Map MF-169, scale 1:7,200, contour interval 100 ft., 1958.

Since 1947, 662 holes have been drilled on Club Mesa by contractors for the U. S. Geological Survey. About 86% of the holes in mineralized layers penetrated host Salt Wash sandstone units 30 ft. or more thick that are in contact with at least 6 in. of green mudstone. If these minimum thicknesses are used as cutoffs, about 10% of the explored area can be classified as favorable for ore, and contains nearly all of the ore reserves discovered. --U. S. Geol. Survey.

1-302. Hackman, R. J. PHOTOGEOLOGIC MAP OF THE ESCALANTE FORKS QUADRANGLE, MESA, MONTROSE, AND DELTA COUNTIES, COLO.: U. S. Geol. Survey, Misc. Inv. Map I-274, scale 1:62,500, lat. 38°30'-38°45'N., long. 108°15'-108°30'W., 1958.

1-303. Bromery, R. W., F. P. Gilbert, and others. AEROMAGNETIC MAP OF LAKE TARLETON AND VICINITY, NEW HAMPSHIRE AND VERMONT: U. S. Geol. Survey, Geophys. Inv. Map GP-196, scale 1:62,500, contour intervals 10 and 50 gammas, lat. 43°50'-44°N., and long. 71°50'-72°15'W., 1958.

1-304. Bromery, R. W., F. P. Gilbert, and others. AEROMAGNETIC MAP OF LITTLETON AND VICINITY, NEW HAMPSHIRE AND VERMONT: U. S. Geol. Survey, Geophys. Inv. Map GP-194, scale 1:62,500, contour intervals 10 and 50 gammas, lat. 44°-44°25'N., long. 71°35'-72°W., 1958.

1-305. Bromery, R. W., F. P. Gilbert, and others. AEROMAGNETIC MAP OF WOODSVILLE AND VICINITY, NEW HAMPSHIRE AND VERMONT: U. S. Geol. Survey, Geophys. Inv. Map GP-195, scale 1:62,500, contour intervals 10 and 50 gammas, lat. 44°-44°25'N., long. 72°-72°15'W., 1958.

1-306. Dane, C. H., and G. O. Bachman. PRELIMINARY GEOLOGIC MAP OF THE SOUTHEASTERN PART OF NEW MEXICO: U. S. Geol. Survey, Misc. Inv. Map I-256, scale 1:380,160, 1958.

The geology is shown of about 25,000 sq. mi., somewhat less than one-quarter of the total area of New Mexico, and the areal distribution of more than 40 different kinds of geologic units ranging from Recent alluvial deposits to granite and quartzite of Precambrian age. It was compiled from numerous detailed and reconnaissance maps and information furnished by oil companies and others. The great southeastward-facing escarpment formed by the Capitan limestone lies in the S.-central part of the area. --U. S. Geol. Survey.

1-307. Colton, G. W., and Wallace de Witt, Jr. STRATIGRAPHY OF THE SONYEA FORMATION OF LATE DEVONIAN AGE IN WESTERN AND WEST-CENTRAL NEW YORK: U. S. Geol. Survey, Oil & Gas Inv. Map OC-54, 1958.

The stratigraphy of the Sonyea formation is shown by an outcrop map, detailed columnar sections (scale 1 in. to 20 ft.), and diagrams. The chart was prepared as part of an investigation of the petroliferous black shales of Upper Devonian age in New York. The formation includes all the rocks between the top of the West River shale and the base of the Rhinestreet shale member of the West Falls formation. A brief text supplements the chart. --U. S. Geol. Survey.

1-308. Moore, George E., Jr. BEDROCK OF THE HOPE VALLEY QUADRANGLE, RHODE ISLAND: U. S. Geol. Survey, Geol. Quad. Map GQ-105, scale 1:31,680, contour interval 10 ft., lat. 41°30'-41°37'30"N., long. 71°37'30"-71°45'W., text, 1958.

The Hope Valley quadrangle is underlain by metamorphic and igneous rocks, which range in age from Precambrian to Devonian(?). Type sections of the Hope Valley alaskite gneiss and the Ten Rod granite gneiss are described. In most of the quadrangle the structural features of the rocks trend northwestward and dip northeastward. The Precambrian Blackstone series was subjected to regional metamorphism and later affected by intrusion of the Scituate granite gneiss. --U. S. Geol. Survey.

1-309. Cattermole, J. M. GEOLOGY OF THE KNOXVILLE QUADRANGLE, TENNESSEE: U. S. Geol. Survey, Geol. Quad. Map GQ-115, scale 1:24,000, contour interval 20 ft., lat. 35°52'30"-36°N., long. 83°52'30"-84°W., 1958.

The city of Knoxville, Tenn., occupies much of the area shown on this map. The underlying rocks range in age from Early Cambrian to Middle Ordovician. Thick residual soils generally mantle the rocks of higher carbonate content. Consistent with this part of the Ridge and Valley province, the structural trend is northeastward and the regional dip is southeastward. The major folds are composite with the smaller superimposed folds duplicating to some extent the form of the larger structure. Two major thrust faults, the Knoxville and Saltville faults, cross the quadrangle. --U. S. Geol. Survey.

1-310. Carswell, L. D., and E. S. Davidson. PRELIMINARY GEOLOGIC MAP OF THE CIRCLE CLIFFS 1 NW QUADRANGLE, GARFIELD COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-154, scale 1:24,000, contour interval 40 ft., lat. 37°52'30'-38°N., long. 111°07'30"-111°15'W., 1958.

1-311. Huff, L. C., and F. G. Lesure. PRELIMINARY GEOLOGIC MAP OF THE VERDURE 1 SW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-164, scale 1:24,000, contour interval 40 ft., lat. 37°45'-37°52'30"N., long. 109°07'30"-109°15'W., 1958.

1-312. Huff, L. C., and F. G. Lesure. PRELIMINARY GEOLOGIC MAP OF THE VERDURE 2 SE QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-163, scale 1:24,000, contour interval 40 ft., lat. 37°45'-37°52'30"N., long. 109°15'-109°22'30"W., 1958.

1-313. Huff, L. C., and F. G. Lesure. PRELIMINARY GEOLOGIC MAP OF THE VERDURE 3 SE QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-167, scale 1:24,000, contour interval 40 ft., lat. 37°30'-37°37'30"N., long. 109°15'-109°22'30"W., 1958.

1-314. Huff, L. C., and F. G. Lesure. PRELIMINARY GEOLOGIC MAP OF THE VERDURE 4 NW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-166, scale 1:24,000, contour interval 40 ft., lat. 37°37'30"-37°45'N., long. 109°07'30"-109°15'W., 1958.

1-315. Lesure, F. G., L. C. Huff, and Frederick Stugard, Jr. PRELIMINARY GEOLOGIC MAP OF THE VERDURE 3 NE QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-165, scale 1:24,000, contour interval 40 ft., lat. 37°37'30"-37°45'N., long. 109°15'-109°22'30"W., 1958.

1-316. Miller, G. A., and R. A. Cadigan. PRELIMINARY GEOLOGIC MAP OF THE CIRCLE CLIFFS 2 NE QUADRANGLE, GARFIELD COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-157, scale 1:24,000, contour interval 40 ft., lat. 37°52'30"-38°N., long. 111°15'-111°22'30"W., 1958.

1-317. Mullens, T. E. PRELIMINARY GEOLOGIC MAP OF THE CLAY HILLS 2 NE QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-184, scale 1:24,000, contour interval 40 ft., lat. 37°22'30"-37°30'N., long. 110°15'-110°22'30"W., 1958.

1-318. Weir, G. W., and C. L. Dodson. PRELIMINARY GEOLOGIC MAP OF THE MOUNT PEALE 3 NE QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-145, scale 1:24,000, contour interval 40 ft., lat. 38°07'30"-38°15'N., long. 109°15'-109°22'30"W., 1958.

1-319. Cuppels, N. P., and F. R. Conwell. PRELIMINARY GEOLOGIC MAP OF THE SOUTHWEST PART OF THE CLIFTON QUADRANGLE, WESTON COUNTY, WYO.: U. S. Geol. Survey, Mineral Inv. Map MF-180, scale 1:7,200, contour interval 20 ft., lat. 43°37'30"-43°40'N., long. 104°03'45"-104°07'30"W., 1958.

1-320. Eckel, E. B., and G. H. Benedict. GEOLOGIC MAP AND SECTIONS OF PARAGUAY: U. S. Geol. Survey, scale 1:1,000,000, contour interval 100 m., 1958.

1-321. Bramkamp, R. A., and L. F. Ramirez. GEOLOGIC MAP OF THE NORTHERN TUWAYQ QUADRANGLE, KINGDOM OF SAUDI ARABIA: U. S. Geol. Survey, Misc. Inv. Map I-207 A, scale 1:500,000, lat. 24°-28°N., long. 45°-48°E., 1958.

1-322. Brown, G. F., and R. O. Jackson. GEOGRAPHIC MAP OF THE SOUTHERN HIJAZ QUADRANGLE, KINGDOM OF SAUDI ARABIA: U. S. Geol. Survey, Misc. Inv. Map I-210 B, scale 1:500,000, lat. 20°-24°N., long. 38°-42°E., 1958.

1-323. Steineke, Max, T. F. Harriss, K. R. Parsons, and E. L. Berg. GEOGRAPHIC MAP OF THE WESTERN PERSIAN GULF QUADRANGLE, KINGDOM OF SAUDI ARABIA: U. S. Geol. Survey, Misc. Inv. Map I-208 B, scale 1:500,000, lat. 24°-28°N., long. 48°-51°E., 1958.

1-324. Steineke, Max, T. F. Harriss, K. R. Parsons, and E. L. Berg. GEOLOGY OF THE WESTERN PERSIAN GULF QUADRANGLE, KINGDOM OF SAUDI ARABIA: U. S. Geol. Survey, Misc. Inv. Map I-208 A, scale 1:500,000, lat. 24°-28°N., long. 48°-51°E., 1958.

## PART 2. AREAL AND REGIONAL GEOLOGY

See also: Stratigraphy 1-378; Igneous and Metamorphic Petrology 1-476; Geohydrology 1-492, 1-493, 1-499; Mineral Deposits 1-502, 1-503, 1-513.

1-325. Douglas, R. J. W. CHUNGO CREEK MAP-AREA, ALBERTA: Canada, Geol. Survey, Paper 58-3, 45 p., illus., Map 6-1958 (in pocket), scale 1 in. to 1 mi., 3 well logs, 1958, refs.

Brief account is given of an area in the central foothills of Alberta underlain by a succession of sediments. These comprise beds of Upper Cambrian, Upper Devonian, Mississippian, Pennsylvanian, Triassic, Jurassic, Cretaceous, and Paleocene age. These sediments are deformed by 3 major W.-dipping thrust faults, the Bighorn, Brazeau, and Ancona thrusts. The overlying thrust sheets have been folded and sliced by numerous subsidiary faults. Several potential oil- and gas-bearing structures lie within the map-area. An anticline in the NE. corner, the Solberg anticline in the Ancona thrust sheet, and the Brazeau structure are 2 of these. Coal seams occur in the Cretaceous and Paleocene rocks.--H. M. A. Rice.

1-326. Norris, D. K. BEEHIVE MOUNTAIN, ALBERTA AND BRITISH COLUMBIA: Canada, Geol. Survey, Paper 58-5, 22 p., illus., Map 14-1958 (in pocket), scale 1 in. to 1 mi., 1958, refs.

This is an advance account of stratigraphy and structure in a highly folded and faulted part of the southern Canadian Rocky Mountains and foothills. Formations range from Devonian to Upper Cretaceous. Many large, low-angled, westerly-dipping thrust faults, including the Lewis thrust, have sliced the formations into a series of thrust sheets in places laid one on top of the other. The Savanna Creek gas field is in the NE. corner of the map-area. This field is explored by 3 completed wells and 2 being drilled; 4 of these are within the map-area. Coal is present in the E. half of the map-area but is not at present of economic value.--H. M. A. Rice.

1-327. Reesor, J. E. DEWAR CREEK MAP-AREA WITH SPECIAL EMPHASIS ON THE WHITE CREEK BATHOLITH, BRITISH COLUMBIA: Canada, Geol. Survey, Mem. 292, 67 p., illus., 5 figs., 7 pls., Map 1053A (in pocket), scale 1:63,360, 1958, 44 refs.

The map-area covers a part of the eastern flanks of the Purcell Range in southeastern British Columbia. It is underlain by Proterozoic sediments of Purcell age belonging to the Aldridge, Creston, Kitchener, Siyeh, and Dutch Creek formations. Into the older of these has been intruded many metadiorite sills, the Moyie intrusions. Sediments and sills alike have been broadly folded in a general northerly direction, cut by one major fault.

Into this complex is intruded a small, stocklike batholith. This body cuts or shoulders aside all formations and truncates the fault. It shows a distinct peripheral foliation and zoning. The core and youngest component is leuco-quartz monzonite followed successively by zones of porphyritic quartz monzonite, hornblende-biotite granodiorite, and, at the margin, biotite granodiorite. Younger but associated intrusions are a small quartz monzonite stock, intrusive into the batholith itself, and aplite and pegmatite dikes. --H. M. A. Rice.

1-328. McCartney, W. D. **GEOLOGY OF SUNNYSIDE MAP-AREA, NEWFOUNDLAND**: Canada, Geol. Survey, Paper 58-8, 21 p., illus., Map 18-1958 (in pocket), scale 1 in. to 1 mi., 1958, refs.

This is a brief account of a map-area that lies on the E. coast of Newfoundland. It is underlain by a succession of Proterozoic and Cambrian sediments, disposed along the E. half of the area into northeasterly-trending folds and cut on the W. half by N. to northeasterly-trending faults and some cross faults. Proterozoic rocks are cut by a body of red granite which is probably of Paleozoic age. --H. M. A. Rice.

1-329. Stevenson, I. M. **TRURO MAP-AREA, COLCHESTER AND HANTS COUNTIES, NOVA SCOTIA**: Canada, Geol. Survey, Mem. 297, 124 p., illus., 9 figs., 6 pls., Map 1058A (in pocket), scale 1:63,360, 1958, 28 refs.

This map-area, which surrounds the town of Truro, Nova Scotia, is underlain by a succession of sediments of Mississippian and Pennsylvanian age, overlain by Triassic arenaceous sediments, and in fault contact with possibly Silurian sediments that are intruded by possibly Devonian granitic rocks. The Carboniferous rocks are gently folded but are dislocated by several steep-dipping block faults.

A deposit at Brookfield contains over 100,000 tons of high-grade barite. A deposit at Smithfield is reported to contain 550,000 tons of 6% combined Pb-Zn in brecciated Windsor (Mississippian) limestone. Other materials known to be present are Mn and Fe, and coal and gypsum. --H. M. A. Rice.

1-330. Behr, Simon H., Jean Dugas, and Wallace B. Emo. **PRELIMINARY REPORT ON PART OF WESTERN DUPRAT TOWNSHIP, ELECTORAL DISTRICT OF ROUYN-NORANDA**: Quebec, Dept. Mines, Prelim. Rept. no. 368, 9 p., fold. geol. map (Prelim. Map no. 1224), scale 1:24,000, 1958.

The map-area lies in NW. Quebec, about 12 mi. NW. of Noranda, in the large belt of clay deposited in the Barlow-Ojibway glacial lake. Below the general level of the former lake, the ground is flat and rocky. Bare ridges rise here and there above the plain. Most of the hills are slightly elongated in the direction of the regional trend, and linear valleys are commonly the loci of faults and shear zones.

All consolidated rocks are Precambrian. The oldest are volcanic and consist of basalt, andesite, dacite and rhyolite. These are intruded by diorite, granite, syenite, a minor body of pyroxenite, and by late Precambrian diabase dikes.

The main structure of the map-area is a broad anticline plunging E., probably the eastern extension of a doubly plunging fold present SW. of the area. Most of the formations follow the general pattern of the fold. Two major faults, one striking NE., the other NW., and marked by linear depressions, meet within the map-area. Several smaller faults are indicated.

Au has been the principal metal found in the region, with one producing mine and other occurrences. Iron pyrite is fairly abundant, and Cu minerals have been found. --A. C. Sangree.

1-331. Béland, Jacques. **PRELIMINARY REPORT ON THE OAK BAY AREA, ELECTORAL DISTRICTS OF MATAPEDIA AND BONAVENTURE**: Quebec, Dept. Mines, Prelim. Rept. no. 375, 12 p., fold. geol. map (Prelim. Map no. 1232), scale 1:63,360, 1958, 8 refs.

The Oak Bay area (48°-48°15'N. 66°30'-67°W.), mapped in summer 1957, covers an area of about 350 sq. mi. in SW. Gaspé Peninsula. Principal physiographic units are the Baie des Chaleurs coastal plain and the Gaspesian plateau. Drainage is directed to the Baie des Chaleurs.

Consolidated rocks range in age from Ordovician to Devonian and include sedimentary and volcanic rocks, intermediate and acidic sills and dikes. Till and moraine, beach and stream deposits, and residual soil compose the unconsolidated cover. Elevated marine terraces border the coastal plain, indicating a higher former, presumably postglacial sea level.

A Pb, Zn, and U prospect and a Cu prospect are described. Quartz veins were found in various places, and assays indicated traces of Ag, Cu, Pb, and Zn. --A. C. Sangree.

1-332. De Romer, H. **PRELIMINARY REPORT ON LAKE ORFORD AREA, ELECTORAL DISTRICTS OF BROME, SHEFFORD AND SHERBROOKE**: Quebec, Dept. Mines, Prelim. Rept. no. 372, 11 p., fold. geol. map (Prelim. Map no. 1228), scale 1:12,000, 1958.

The Lake Orford area (45°15'-45°20'N. 72°15'-72°20'W.), mapped in summer 1957, lies about 20 mi. WSW. of Sherbrooke and W. of Lake Memphremagog in the Eastern Townships, and covers about 22 sq. mi. in the Appalachian uplands. The region is underlain by Paleozoic rocks. In the western half, thick sequences of Cambrian(?) schist of the Sutton facies are overlain by and grade E. into rocks of the Caldwell facies - massive graywacke, sub-graywacke, and interbedded arenite and slate, rhyolitic and andesitic flows. The Beauceville slate and quartzite succession (Ordovician?) apparently unconformably overlies the Caldwell rocks. Thick lava flows make up the western and eastern slopes respectively of Orford and Chagnon mountains. These flows have been intruded by a complex of intermediate to ultrabasic rocks. Several circular bodies of relatively unaltered granite cropping out near the SW. corner of the area probably represent the youngest intrusions. Large parts of the northern half of the map-area are covered by thick glacial stream deposits and morainic material as well as by recent sand and gravel.

Indications are that rocks of the Sutton and Caldwell facies have been isoclinally folded into NNW.-trending folds, the axial planes of which dip steeply to the E. A continuous breccia zone averaging about 1000 ft. in width extends in a SSW. direction from W. of Orford Lake to the southern limit of the area. It probably indicates a major zone of dislocation.

Cu occurrences of economic importance have been found in the NE.-trending belt of volcanic rocks of andesitic to basaltic composition in the SW. corner of the map-area. Quebec Copper Corporation Ltd. is now mining ore at the rate of 800 tons per day at one property. Ore reserves were estimated in Sept. 1957 at 600,000 tons averaging 1 to 1.5% Cu. Some asbestos, pyrite, chromite, and marble were found. --A. C. Sangree.

**1-333.** Gelinas, Leopold. **PRELIMINARY REPORT ON GABRIEL LAKE (WEST HALF), NEW QUEBEC: Quebec, Dept. Mines, Prelim. Rept. no. 373, 10 p., fold. geol. map (Prelim. Map no. 1227), scale 1:63,360, 1958, ref.**

The W. half of Gabriel Lake area (68°45'-69°N. 58°-58°15'W.), mapped in summer 1957, covers 160 sq. mi., about 18 mi. W. of Fort Chimo. All consolidated rocks are of Precambrian age. The southern part of the map-area is underlain mainly by pink and gray gneiss and a relatively narrow belt of biotite schist. The eastern part is underlain mainly by gray gneiss. Between these areas of gneiss is a sector consisting mainly of a great variety of schists. Biotite-muscovite schist, diopside-biotite schist, and sillimanite schist are the most common. All the gneisses and schists have layers of amphibolite parallel to the schistosity. The complex is cut by pegmatite dikes. Tops of ridges are generally bare, while valleys are floored by glacial drift. The southern part of the map-area, and a wide area in the NE. are blanketed by sand and gravel.

Massive limonite occurs in the schist near an amphibolitic layer at one locality. At several places disseminated chalcopyrite, pyrite, and pyrrhotite occur in amphibolite. Lenses of iron formation are present but are poorly exposed and have a low magnetite content. --A. C. Sangree.

**1-334.** Gilbert, J. E. **BIGNELL AREA, MISTASSINI AND ABITIBI TERRITORIES, ABITIBI-EAST AND ROBERVAL ELECTORAL DISTRICTS: Quebec, Dept. Mines, Geol. Rept. 79, 40 p., 11 illus. on 6 pls., col. geol. map (in pocket), scale 1:63,360, 1958, 30 refs.**

The Bignell area (50°-50°15'N. 73°45'-74°W.) covers 200 sq. mi., about 20 mi. NE. of Chibougamau Lake and 10 mi. S. of Mistassini Lake. Most of the area is underlain by early Precambrian rocks including volcanic and sedimentary rocks, a gneissic complex, and granitic intrusions. In the northern part, some late Precambrian rocks include 2 sedimentary groups and diabase and basic dikes. Early Precambrian rocks are in tight folds, striking and plunging ENE. The late Precambrian rocks are gently folded. Two major faults, apparently thrusts, and several secondary faults have been recognized. The Pleistocene ice sheets left few traces of erosion, but many constructive features, the most prominent being drumlinoid ridges, especially abundant in the western half of the area.

Evidence of mineralization is widespread. Chalcopyrite was seen at a number of places, also pyrite and pyrrhotite, and some sphalerite and galena. Little prospecting had been done prior to 1950, the time of the author's survey. --A. C. Sangree.

**1-335.** Horscroft, F. D. M. **PRELIMINARY REPORT ON THE SOUTHWEST QUARTER OF ROY TOWNSHIP, ABITIBI-EAST ELECTORAL DISTRICT: Quebec, Dept. Mines, Prelim. Rept. no. 370, 17 p., fold. geol. map (Prelim. Map no. 1221), scale 1:12,000, 1958, 2 refs.**

Mapping was carried out during summers 1955 and 1956 in a 25-sq. mi. area at the N. end of Chibougamau Lake, 300 mi. N. of Montreal. Relief is diversified, with differences in elevation of about 600 ft. About one-third of the area is occupied by Chibougamau and Doré lakes.

All consolidated rocks are Precambrian. The oldest form an assemblage of Keewatin-type metamorphosed volcanics including metabasalts, meta-andesites, some metarhyolite, metadiabase, and many interlayered fine- to medium-grained pyroclastic rocks. These form an easterly-trending belt across the center of the map-area. To the S. lie altered anorthosite, related anorthositic rocks, and metagabbro. In the N. the volcanic rocks are intruded by a series of ultrabasic rocks - serpentinite, periodotite, pyroxenite, and gabbros. Small granite bodies and feldspar porphyry dikes intrude the volcanic rocks and the altered anorthosite. Some syenite is present. The volcanic rocks, syenite, and gabbro are overlain unconformably by gently-dipping conglomerates of the late Precambrian Chibougamau series.

The volcanic sequence is part of the vertical S. limb of a major syncline, the axis of which lies within the northern confines of the area. Faults and strongly-sheared zones are present and have a general E.-W. trend.

Scattered sulfide mineralization is widespread. Cu, Zn, Pb, pyrite, Au, molybdenite, Fe ore, and asbestos occur within the map-area. Fifteen mining properties are described. --A. C. Sangree.

**1-336.** Jooste, René F. **BOURGET AREA, CHICOUTIMI AND JONQUIÈRE-KÉNOGAMI ELECTORAL DISTRICTS: Quebec, Dept. Mines, Geol. Rept. 78, 42 p., 15 illus. on 12 pls., 2 col. maps (in pocket): geol. map, scale 1:63,360, map of titaniferous magnetite deposits, scale 1 in. to 400 ft., 1958, 27 refs.**

Bourget area (48°30'-48°45'N. 71°15'-71°30'W.) lies within the Lake St. John - upper Saguenay lowland, N. of the Saguenay River and about 15 mi. E. of Lake St. John. Consolidated rocks are Precambrian and igneous, except for 2 small down-faulted areas of Ordovician (Trenton) limestone. Anorthosite and related rocks occupy about two-thirds of the area and contain extensive deposits of titaniferous magnetite. Four younger intrusive groups range from diorite to granite. Pleistocene deposits consist of till and glacial outwash, overlain in lower parts of the area by clay and sand deposited during a postglacial marine inundation.

The titaniferous magnetites are the only known deposits of metallic minerals in the area. Of these, the St. Charles deposits are the largest. The magnetite occurs as irregular lenticular masses in rocks of the anorthosite group. In this report, rocks consisting predominantly of magnetite and ilmenite are referred to as titaniferous magnetite, although olivine, apatite, and other minerals may constitute up to 50% of the rock. The titaniferous magnetite is classed as phosphatic or as phosphorus-poor, the former containing 5 to 30% apatite by volume, the latter containing less than 5% apatite. The deposits may be considered as a possible source of Fe, Ti, and P. Compared with the deposits at Allard Lake, the St. Charles deposits average higher in Fe and lower in titanium oxide.

The deposits cannot be regarded as a segregation and there is little evidence for replacement. Evidence indicates that they were formed by the injection of a residual magma that was kept liquid by its unusual composition and was derived by filter-pressing of partly consolidated ophitic anorthositic troctolite.

Non-metallic deposits include mica and calcite. Building stone, sand, and gravel are utilized, and clay is a potential economic resource. --A. C. Sangree.

**1-337. Klugman, M. A. PRELIMINARY REPORT ON BOUCHER - CARIGNAN AREA, LAVIOLETTE ELECTORAL DISTRICT: Quebec, Dept. Mines, Prelim. Rept. no. 376, 6 p., fold. geol. map (Prelim. Map no. 1229), scale 1:63,360, 1958.**

The Boucher-Carignan area (47°-47°15'N. 72°45'-73°W.), mapped during summer 1957, covers approximately 205 sq. mi. along the St. Maurice River, about 130 mi. NW. of Quebec City. The region lies within the Laurentian uplands, with local relief up to 900 ft. Moraine mantles much of the area.

Consolidated rocks are all Precambrian. In order of abundance they are: paragneisses and orthogneisses (which underlie more than two-thirds of the area), granite, gabbro and various minor intrusives. Most of the paragneisses have been injected by granitic material. Except locally, the gneissic structures strike N. and dip E. Near the granitic and gabbroic masses the regional trend has been greatly disrupted by these intrusions. Several folds have been traced in the field. Jointing is common throughout the area, particularly in the massive igneous rocks. Two faults were found.

Disseminated magnetite, pyrite, and pyrrhotite were found; also large flakes of graphite and books of biotite as much as 9 in. across. Nearly all pegmatites in the area show radioactivity slightly greater than background. Many sand and gravel deposits along the St. Maurice River are being worked. --A. C. Sangree.

**1-338. Laurin, A. F. PRELIMINARY REPORT ON BEAUMOUCHEL - HOUDET AREA, ELECTORAL DISTRICT OF PONTIAC: Quebec, Dept. Mines, Prelim. Rept. no. 367, 6 p., fold. geol. map (Prelim. Map no. 1223), scale 1:63,360, 1958, 2 refs.**

The Beaumouchel-Houdet area (47°-47°15'N. 77°-77°15'W.), mapped during summer 1957, covers about 200 sq. mi. approximately 125 mi. NW. of Ottawa. The surface is gently rolling, with local relief commonly less than 300 ft. Most of the area is mantled by glacial debris, and exposures are sparse.

All consolidated rocks are Precambrian, with textures and structures indicating that they form part of the Grenville sub-province. Most of the area is underlain by 3 main groups of rocks, in order of age, paragneisses, injection gneisses, and orthogneisses. Ultrabasic rocks intrude the paragneisses and injection gneisses along Ninemile Lake. Pink granite and pegmatite, relatively scarce, are the youngest consolidated rocks.

Structural trend is generally E.-W. All rocks have been folded, but the intensity of folding varies from one part of the area to another. A few small faults, with apparent displacements of only a few inches, were seen; no extensive faults were recognized. Three main sets of joints were noted: one striking W. to NW., another, N., and a third, NE.

Late in 1956, disseminated magnetite was discovered in the southern part of the map-area. The ore minerals are in biotite or in garnetiferous biotite paragneisses. Specks of molybdenite occur in one locality. --A. C. Sangree.

**1-339. Longley, W. W. RINFRET AREA, ELECTORAL DISTRICTS OF ABITIBI-EAST AND ROBERVAL: Quebec, Dept. Mines, Geol. Rept. 81, 21 p., 24 illus. on 12 pls., col. geol. map (in pocket), scale 1:63,360, 1958, 2 refs.**

The Rinfret area (49°45'-49°50'N. 73°45'-74°W.) comprises 200 sq. mi. immediately E. of Chibougamau Lake and 110 mi. NW. of Lake St. John. It is an area of gentle relief, modified by glaciation and generally mantled by thin glacial deposits. Consolidated rocks are Precambrian. In the eastern part, bedrock is mainly biotite gneiss and hornblende gneiss. In the west, the dominant rocks are hornblende schist, anorthosite, gabbro, diorite, granite, and syenite; some volcanic and sedimentary rocks are present.

The structural trend is NNE. to NE., with dips generally to the E. Shear zones are common and are assumed to be related to faults in most instances.

The most promising indications of mineral deposits were found near the NW. corner of the area, just N. of an intrusion of anorthosite. Here chalcopyrite was observed in several places in a half-mile-wide belt of altered volcanic and sedimentary rocks. This belt is apparently continuous with the O'Leary-Malartic Cu prospect a short distance W. A considerable amount of disseminated magnetite occurs in the western part of Rinfret Township, in the hornblende schist, and, to some extent, in the adjacent anorthosite-gabbro. Analysis of a specimen of magnetite gave values of 53.12% Fe and 7.57% Ti. --From auth. introd.

**1-340. McPhee, Duncan S. PRELIMINARY REPORT ON ERIC LAKE AREA, SAGUENAY ELECTORAL DISTRICT: Quebec, Dept. Mines, Prelim. Rept. no. 369, 5 p., fold. geol. map (Prelim. Map no. 1226), scale 1:63,360, 1958, 5 refs.**

The Eric Lake area (65°35'-65°50'N. 51°45'-52°10'W.), mapped during summer 1957, covers about 320 sq. mi. along the Quebec North Shore and Labrador Railway. The area lies within the Laurentian uplands at about 2,000 ft. above sea level, with local relief of about 300 ft. Glacial deposits mantle most of the region.

All consolidated rocks are Precambrian. Oldest are metasedimentary and associated igneous rocks. Intrusives include gneissic granite, gabbro, diorite and related rocks, pink biotite granite, pegmatite and lamprophyre dikes. The bands of paragneiss, occupying about one-third of the area, form the main structural unit. Structural trend of the gneisses is NE. Asymmetrical and cross folds, however, produce a generally complex structure.

No concentration of economic minerals was found, although finely-disseminated magnetite occurs within the gabbro bodies. Glacial deposits have provided fill for the Quebec North Shore and Labrador Railway. --A. C. Sangree.

**1-341. Phillips, Laurence S. PRELIMINARY REPORT ON TUTTLE LAKE AREA, SAGUENAY ELECTORAL DISTRICT: Quebec, Dept. Mines, Prelim. Rept. no. 377, 8 p., fold. geol. map**

(Prelim. Map no. 1234), scale 1:63,360, 1958.

The Tuttle Lake area (52°30'-52°45'N. 67°30'-67°45'W.), mapped in summer 1957, lies approximately 175 mi. NNW. of Sept-Iles and covers about 183 sq. mi. Outcrops are fairly abundant in the southern half of the map-area, but much of the northern and western section is covered by muskeg and low boulder ridges of glacial origin.

All consolidated rocks are Precambrian. They probably represent, in part, the metamorphosed southwesterly extension of the iron-bearing sequence of the Labrador Trough. From N. to S. the rock types consist of biotite gneisses and migmatites, with amphibolites and granite gneiss; amphibolite-free biotite schists and gneisses and migmatites; iron formations, including quartzites and crystalline marbles; and hornblende-biotite gneiss. Except for a small mass of gabbro, all the rocks are of high metamorphic grade.

Structure is complex. The rocks are folded into tight isoclinal and overturned folds, mostly trending NNW. A few faults were mapped in the southern part of the area; they are probably somewhat later than the main folding.

The iron formations are believed to be the southwesterly continuation of those of the Mount Wright-Wabush Lake region. Magnetic and outcrop information indicate that no iron deposits of value occur in the northern part of the region. Several companies, however, hold claims in the southern half. The economically valuable ore occurs as magnetite-quartzite, magnetite-hematite quartzite, and hematite (specularite) quartzite. --A. C. Sangree.

**1-342. Ellis, C. Howard. GEOLOGY AND PENNSYLVANIAN PALEONTOLOGY OF PERRY PARK, COLORADO: Compass, v. 36, no. 2, p. 70-84, geol. map, pl., Jan. 1959, 23 refs.**

About 35 mi. S. of Denver, Colorado, sediments of Cambrian through Paleocene ages crop out in Perry Park and form northward-dipping hogbacks. A calcareous interval approximately 20 ft. in thickness is present 240 ft. above the base of the Pennsylvanian Fountain formation. This unit contains a varied silicified fauna which indicates that at least this lower portion of the Fountain formation is of Morrowan age. Because this fossiliferous interval is underlain by coarse arkosic sandstones and conglomerates, it also suggests an early Pennsylvanian age, or earlier, for the initial stage of the ancestral Rocky Mountain uplift. --Auth.

**1-343. Beck, Henry V. GEOLOGY AND GROUND-WATER RESOURCES OF KANSAS RIVER VALLEY BETWEEN WAMEGO AND TOPEKA VICINITY: Kansas, State Geol. Survey, Bull. 135, 88 p., figs., pls., maps, cross-secs., 1959.**

The geography, geology, and ground-water resources of Kansas River valley from Kiro in Shawnee County to the W. boundary of Range 10 E. in Pottawatomie County are described in this report. The area comprises about 280 sq. mi., including parts of Shawnee, Wabaunsee, and Pottawatomie counties. It is a major agricultural area and a potential industrial area.

The indurated rocks, limestone, shale, and sandstone of Pennsylvanian and Permian age, dip gently westward to the Nemaha anticline, where the dip reverses. These rocks are the source of construction materials and small but important quantities of ground water. Unconsolidated Pleistocene sediments blanket much of the area N. of the river, and sediments representing all subdivisions of the Pleistocene series are present. The Illinoian and Wisconsinan terrace deposits and Wisconsinan and Recent alluvium are the most prolific sources of ground water, yielding large supplies for irrigation and muncipal wells. The principal use of ground water is for irrigation, and the data indicate that the supply of ground water is sufficient for additional development of irrigation and industrial supplies.

Well logs, water-level measurements, aquifer-test data, and chemical analyses are given. --Auth.

**1-344. Hughes, Richard John, Jr. KEMPER COUNTY GEOLOGY: Mississippi State Geol. Survey, Bull. 84, 274 p., 65 figs., 16 pls., incl. geol. map, scale 1:41,184, 1958, 486 refs.**

Kemper County is one of the border counties of E.-central Mississippi with an area of 754 sq. mi. The sediments which crop out range in age from Upper Cretaceous to Tertiary. Locally, these are covered by surficial deposits of Quaternary age, represented by flood-plain deposits. The Cretaceous section consists of chalks and sandy chalks of the Selma group, the outcropping units of which are the Demopolis chalk and its Bluffport marl member, the Ripley formation, and the Prairie Bluff chalk.

The Tertiary sediments consist of interbedded sands and clays, clays, and chalk. The Midway group is represented by the Clayton formation and the Porters Creek clay. The Wilcox group is composed of the Nanafalia formation and its Fearn Springs sand member, the Tuscahoma formation, and the Hatchetigbee formation with the Bashi marl member at the base. In the extreme southwestern part of the county sands of possible Claiborne age were mapped as the Meridian sand.

The Cretaceous rocks contain an abundant fauna. Exogyra costata, Anomia tellinoides, Paranomia scabra, and other fossils were collected. The Clayton formation is also fossiliferous. Fossils from the Wilcox are scarce and difficult to identify.

The outcropping formations were traced into the subsurface through the use of electric logs and surface nomenclature used in the subsurface study.

The geological structure of Kemper County is a gently dipping arcuate homocline, in which the beds dip approximately 42 ft. per mi. to the SW.

Economic studies were made of water, Fe ore, sand, clay, bauxite, lignite, and phosphates. --Auth.

**1-345. Myers, Arthur J. GEOLOGY OF HARPER COUNTY, OKLAHOMA: Oklahoma Geol. Survey, Bull. 80, 108 p., illus., maps (incl. 2 geol. maps, oil & gas map in pocket), 2 cross-secs. (in pocket), 4 tables, Feb. 1959, 94 refs.**

Harper County, with an area of approx. 1,075 sq. mi. is in northwestern Oklahoma. Aerial photographs were used in the field mapping of this semiarid region. The bed rock consists of Permian clastic and evaporite sediments and Cretaceous clastics approximately 535 ft. thick, covered in the SW. by about 135 ft. of Pliocene and Pleistocene continental deposits. The region is in the Plains Border of the High Plains physiographic province and most outcrops of Permian rocks are bluff exposures.

In ascending order, the unfossiliferous Permian rocks consist of the Flowerpot shale, Blaine formation, Dog Creek shale, Whitehorse group, and Cloud Chief formation. The Flowerpot shale is a brownish-red gypsiferous shale. The Blaine formation consists of 4 named massive gypsum members separated by red shale: (ascending) Medicine Lodge, Nescatunga, Shimer, and Haskew gypsums. The Dog Creek shale is a brownish-red, even-bedded shale with thin beds of fine-grained sandstone. The Whitehorse group includes the Marlow formation, which is orange-red, fine-grained, locally cross-bedded sandstone, and the overlying Rush Springs sandstone, consisting of brownish-red interbedded sandstone and shale. The Cloud Chief formation is predominantly a maroon-red shale with some gypsum and contains the resistant Day Creek dolomite at its base. The Cretaceous Kiowa shale in outliers consists of yellow to gray to black shales, sandstones, and conglomerates with some fossiliferous beds. The Pliocene deposits include (ascending) the Laverne formation, buff, blue-gray, and gray shales, sandstone, and conglomerates, and the Ogallala formation, pink, tan, and gray gravels, sands, and silts. The Pleistocene deposits are the Crooked Creek formation of the Meade group, which consists of tan to pink gravels, sands, and silts, and the Pearlette volcanic-ash lentil, post-Crooked Creek dune sand, and gray to black clay and silt lake deposits. The Recent deposits are the terraces, alluvium, and dune deposits along recent streams.

During Permian time clastics and evaporites accumulated in marine embayments which covered western Oklahoma. Following this, a period of erosion lasted during most of the Triassic and Jurassic periods. By Cretaceous time, marine seas again covered the extreme western part of Oklahoma and received clastic sediments from the W. Erosion again predominated during most of the Tertiary, but during the Pliocene 2 cycles of fluvial deposition by E.-flowing streams were separated by an intervening period of erosion. Later Pleistocene meltwater streams from the retreating Rocky Mountain glaciers eroded channels in the pre-Pleistocene surface, but a cycle of fluvial deposition followed soon after. The last episode of Pleistocene history involved the deposition of lacustrine sediments in shallow sink basins of local extent.

The Permian and Cretaceous rocks have a dip of 30 ft. per mi. to the S. The Tertiary and Quaternary deposits are essentially horizontal. Sink hole development has resulted in minor localized folding in all rocks. Isolated sand and gravel deposits are used locally for road construction. The massive gypsum deposits of the Blaine formation may have economic possibilities. The volcanic-ash deposits are small and would not permit large scale operation.

A section on petroleum geology by Louise Jordan, J. Durwood Pate, and Sidney R. Williamson describes subsurface conditions as presently understood. Petroleum exploration in Harper County has resulted in the discovery of commercial oil and gas production in at least 8 stratigraphically separated reservoirs ranging in age from Lower Ordovician to Permian. Subsurface stratigraphy and structure of the county are described and illustrated with E.-W. and N.-S. electric-log cross-sections, by contour maps at the top of the Mississippian and top of the Oread formation (Pennsylvanian), and with isopach maps of Morrowan and Chesterian rocks. Isopach and structure maps of the Laverty-Hoover sand zone in the Laverne Gas Area are included. --Auth.

**1-346. Smith, Fred E. UPPER AND MIDDLE TERTIARY OF BRAZOS RIVER VALLEY, TEXAS: 48 p., 12 illus., 2 maps, Bryan, Texas, Society of Economic Paleontologists and Mineralogists (Gulf Coast Section) and Houston Geological Society, Dec. 1958, 32 refs.**

The Guidebook was published in order to show field-trip participants how to reach the exposures of rocks deposited during marine transgressions and also nonmarine strata of regressive sequences along the Upper and Middle Tertiary of the Brazos River valley, Texas. It also includes data on the rocks exposed. The field trip covered by this Guidebook started at Independence in Washington County, Texas, on the outcrop of the Miocene Oakville formation and followed along the Brazos River, visiting a total of 9 excellent outcrops, and ending at the Weches-Sparta contact of the Eocene Claiborne near Burleson Bluff on the Brazos River. The Guidebook is complete and authoritative and includes a geological map and a highway map of the area as well as idealized and columnar sections, air photographs, an illustrated road log, and an annotated bibliography. --Houston Geol. Soc.

**1-347. Kurdyukov, K. V. K GEOLOGICHESKOMU RAZVITIYU PRIBALKHASHYA V POZDNEM KAYNOZOYE [THE GEOLOGICAL DEVELOPMENT OF THE BALKHASH REGION DURING THE LATE CENOZOIC ERA]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 23-46, illus., 3 maps, 1958, 30 refs.**

The article deals with the Cenozoic structure, sedimentation, and several geomorphologic peculiarities of the Balkhash region [46°N. 74°E.] The author endeavors to present a composite cross-section of Tertiary deposits, to estimate the depth of the Paleozoic base, and give other characteristic data of the Balkhash depression. According to the outcrops of Paleozoic rock formations, the Balkhash depression can be subdivided into 7 areas, of which a detailed description is given. As to the tectonic structure of this little known area, the opinion expressed by B. A. Petrushevsky is in accord with those of N. S. Shatsky, i.e., the Balkhash depression is composed of several separate synclines, which are basically of Quaternary origin. It must be assumed that the Balkhash region was fairly level at the beginning of the Tertiary. The exact time of the beginning of the tectonic movements, which have transformed the Tertiary layers of this region, cannot be determined for lack of stratigraphical data. They are thought to have taken place during the second half of the Tertiary (at the end of the Miocene or beginning of the Pliocene). The major elevations and depressions had already been formed at the beginning of the Quaternary. The Cenozoic movement of the earth's crust resulted in the forming of folds and faults. The latter occurred more frequently in the eastern part of the region. The crustal elevation in regions of present mountains was considerably greater than the subsidence of present depressions. Lakes were formed in the depressions prior to the advent of the Quaternary. However, details of their origin are as little known as are details of the depths of Paleozoic layers. --LC.

## 2. GEOMORPHOLOGY

See also: Geophysics 1-428; Geochemistry 1-454.

**1-348.** Gajda, Roman T. CRYOCONITE PHENOMENA ON THE GREENLAND ICE CAP IN THE THULE AREA: Canadian Geographer, no. 12, p. 35-44, maps, dias., tables, 1958, ref.

Quantitative studies on cryoconite phenomena on the Greenland ice cap were carried out in the Thule area in 1949. Data are presented on morphological characteristics of cryoconite holes and an examination made of the relationship between their size, width, and depth, and between their sizes in relation to distance from ice margin. It was concluded that although seasonal cycles did affect cryoconite holes, the changes in their main characteristics, such as their depth, could best be explained by long term climatic cycles. Other cryoconite phenomena such as stripes and cryoconite cover were observed. Some practical applications of the study of cryoconite phenomena are indicated. --F. A. Cook.

**1-349.** Hattersley-Smith, G. GLACIOLOGICAL RESEARCH IN NORTHERN ELLESMERE ISLAND: Canadian Geographer, no. 12, p. 32-34, 1958.

An expedition under the sponsorship of the Defence Research Board of the Canada National Research Council spent 18 months in the Lake Hazen area as part of the International Geophysical Year program. The purpose of the study was to make quantitative measurements of existing glaciers and to provide information on the regime of the ice cap.

The fact that northern Ellesmere Island has a relatively thin and limited ice cap in striking contrast to the great mass of the Greenland ice cap to the SE. is attributed to the very low precipitation in the area, which averages only about 4 1/2 in. water equivalent at Alert. It appears that the climatic amelioration which culminated in the late 1930's or early 1940's had less effect on the ice cover in northern Ellesmere Island than in other parts of the Arctic, as for example northern Norway and Spitzbergen. --F. A. Cook.

**1-350.** Dreimanis, A., and J. Terasmae. STRATIGRAPHY OF WISCONSIN GLACIAL DEPOSITS OF TORONTO AREA, ONTARIO: Geol. Assoc. Canada, Proc., v. 10, p. 119-35, 3 figs. incl. geol. map, 5 tables, Dec. 1958, 37 refs.

Lithologic and pollenanalytic studies suggest the following sequence of events during the Wisconsin glacial age in the Toronto area, north of Lake Ontario:

1. Early Wisconsin (pre-classical Wisconsin) glaciation, with regional ice flow entering Lake Ontario from NE. via the St. Lawrence depression; deposition of the lower Wisconsin till with a matrix more dolomitic than in the overlying tills;
2. Long, cool interstadial, probably equivalent to the Port Talbot interval in the Lake Erie region and the St. Pierre interval in St. Lawrence Lowland, older than 34,000 radiocarbon years, with spruce and pine forests;
3. Main Wisconsin glaciation, equivalent to the classical Wisconsin. The principal glacial flow entered the Lake Ontario basin across the area W. of the St. Lawrence-Ottawa region at its maximum. The middle till was deposited in the Toronto area, at some time, while the fluctuating ice margin of this glacial episode was forming the Farmdale, the Iowan (?), the Tazewell, and the Cary drifts in the midwestern United States. The Ontario lobe retreated in the lake basin during an interval, probably equivalent to the Two Creeks interstadial, readvancing again and depositing the upper till, rich in local shale (Valders advance?). A centre of glacial outflow may have existed in the Lake Ontario depression during this last advance. --Auth.

**1-351.** Brummer, J. J. GLACIATION IN THE NORTHWEST QUARTER OF HOLLAND TOWNSHIP, GASPÉ NORTH COUNTY, QUEBEC: Geol. Assoc. Canada, Proc., v. 10, p. 109-17, fold. map, 2 cross-secs., Dec. 1958, 15 refs.

The extent of Pleistocene glaciation (Wisconsin stage or the Laurentide ice-sheet) onto the Gaspé Peninsula has been a controversial subject in the past. This paper describes the glacial features observed while mapping a small area in the N.-central section of the Peninsula. The study of glacial striae and distribution of erratics indicate that a local ice sheet was located over the Béland-Upper York Highlands. This sheet travelled to the N. and NE. and was followed by valley glaciation. No evidence of continental glaciation was observed. --Auth.

**1-352.** Taillefer, François. LA MORPHOLOGIE DES ENVIRONS DE QUÉBEC ET LA BASSE-VALLÉE DU SAINT-LAURENT [THE MORPHOLOGY OF THE QUEBEC REGION AND THE LOWER ST. LAWRENCE VALLEY (in French, with English Summ.)]: Cahiers de Géographie de Québec, année 2, no. 4, p. 177-91, 5 figs. incl. maps, cross-secs., Apr.-Sept. 1958, 6 refs.

The morphology of the Quebec region and the lower St. Lawrence valley is reappraised in this article divided in 3 parts. The physical landscape is described in pt. 1, the structural conditions are examined in pt. 2, and the morphological problems are presented in pt. 3.

The relief is the result of a succession of glacial episodes and submersion and emersion episodes which followed glaciation. The overdeepening of the Limoilou depression and the opening of Calvaire lake and Cap Rouge depressions are the results of the glacier. To the submerged phase corresponds the alluvial fill, especially thick in the Limoilou depression. During the emersion phase the St. Lawrence cut in soft schists the Ancienne Lorette and the lower terrace which would have been shaped after the overdeepening of the Limoilou depression. --Auth.

**1-353.** Sharp, Robert P., Clarence R. Allen, and Mark F. Meier. PLEISTOCENE GLACIERS ON SOUTHERN CALIFORNIA MOUNTAINS: Am. Jour. Sci., v. 257, no. 2, p. 81-94, 2 pls., 7 maps, 2 tables, Feb. 1959, 13 refs.; also pub. as: California Inst. Technology, Div. Geol. Sci., Contr. no. 902.

The deposits of 7 valley glaciers have been mapped in the San Gorgonio area of the San Bernardino Mountains in southern California. These ice bodies headed at elevations between 10,300 and 11,300 ft., the lowest elevation attained was 8700 ft., and lengths were 0.5 to 1.7 mi. Dry Lake glacier was the largest. It covered 0.84 sq. mi. on the N. slope of San Gorgonio Mountain.

The principal products of glaciation are cirques and huge terminal embankments of coarse angular debris up to 700 ft. high. Sharp-crested end moraines, typical recessional loops, and a number of other relations indicate that these embankments were formed by glaciers rather than as rock glaciers or debris flows. Two separate episodes of glaciation are recognized; both are considered Wisconsin.

Features previously attributed to glaciers in the San Gabriel Mountains were restudied. It is concluded that this range escaped glaciation in the Wisconsin and probably all earlier Pleistocene stages. San Jacinto Peak may have been glaciated, but definite proof has not yet been found. --Auth.

**1-354. Cook, Frank A. SELECTED BIBLIOGRAPHY ON CANADIAN PERMAFROST: Canada, Dept. Mines & Tech. Surveys, Geog. Branch, Bibliog. Ser. no. 20, 23 p., 1958.**

Investigations into the problems associated with permafrost form an integral part of the Canadian Geographical Branch's program for research. The references to permafrost in Canada are widely scattered in the literature, and this bibliography brings them together in the form of annotations and abstracts. --Auth.

**1-355. Cook, Frank A. SORTED CIRCLES AT RESOLUTE, N.W.T.: Geog. Bull., no. 11, p. 79-82, illus., figs., 1958.**

Sorted stone circles were excavated in detail and quantitative field data are presented on their geometry and composition. --Auth.

**1-356. Ives, J. D. MOUNTAIN-TOP DETRITUS AND THE EXTENT OF THE LAST GLACIATION IN NORTHEASTERN LABRADOR-UNGAVA: Canadian Geographer, no. 12, p. 25-31, illus., 1958, ref.**

The purpose of this paper is to examine the possible time factor in development of mountain-top detritus in the Labrador-Ungava area. Some previous writers assumed that post-glacial time had been sufficiently long for the formation of the mountain-top detritus that is found today in various parts of eastern Canada. Others argue that the mature development of detritus requires a much longer period, and that mature forms probably antedate the last glaciation. If agreement can be reached regarding the time factor, it may or may not be possible to use the presence of mature detritus as an indication of the persistence of an ice-free area (nunatak) during the maximum of the last glaciation. The present paper considers the problem theoretically owing to the lack of quantitative work on the process of frost-shatter. Based on field observations it arrives at the conclusion that mountain-top detritus may be used as an indication of the persistence of ice-free areas in the Torngat Mountains throughout the last glaciation, and the initiation of the detritus may be assigned to the closing phases of the penultimate glaciation. The correlation of the 2 most recent Torngat glaciations with the standard chronology of central North America is not yet possible. The earlier of the 2 (Torngat glaciation) may be of Illinoian age or it may be post-Sangamon and pre-Wisconsin. The final (Koroksoak) glaciation is probably the equivalent of the "classical" Wisconsin. --F. A. Cook.

**1-357. Hamelin, Louis-Edmond. LES COURS D'EAU A BERGES FESTONNEES [STREAMS WITH CONVOLUTED BANKS]: Canadian Geographer, no. 12, p. 20-24, illus., 1958, ref.**

Field observations were made on the convoluted banks of some streams in the Abitibi district, NE. Quebec. A description is given of this fluvio-geomorphological feature, and it is suggested that the feature may be of periglacial origin, related to former occurrence of ground ice-lenses since enlarged by contemporary fluvial action. --F. A. Cook.

**1-358. Corbel, Jean. LES KARSTS DE L'EST CANADIEN [KARSTS OF EASTERN CANADA (in French, with English summ.)]: Cahiers de Géographie de Québec, année 2, no. 4, p. 193-216, 4 illus., 14 figs. incl. geol. maps, Apr.-Sept. 1958, 18 refs.**

This is a systematic study of karsts in eastern Canada, especially caves and underground streams. The analysis of the limestone content in the water has been used to study the actual dissolution of limestone. It has been deducted that some of the most typical caves, such as the Saint-Casimir cave in Portneuf County, were formed 3,500-4,000 years ago. This dating is cross-examined with other factors supplied by the physical geography of the area: ice retreat, study of pollens, $C^{14}$ analysis, post-glacial surrection, etc.

The evolution of the limestone coast of the Mingan-Anticosti area is also described. Everywhere, in the Mingan area and the Anticosti region as well as in the Saint-Casimir cave, erosion is very rapid. It is a constant fact in regions with heavy snowfalls, as demonstrated in similar regions of Norway and Alaska.

The climatic influence on the shape and speed of karstification is a determinant factor. --Auth.

**1-359. Senstius, M. W. CLIMAX FORMS OF ROCK-WEATHERING: Am. Scientist, v. 46, no. 4, p. 355-67, 6 illus., 2 figs., Dec. 1958, 6 refs.**

Climax forms of rock-weathering are those which have reached dynamic equilibrium with their climatic environment. Temperatures and the ratio of average annual precipitation to evaporation are the most important climatic factors in producing climax forms of rock-weathering. The presence and absence of organic matter are also intimately related to these 2 principal climatic factors.

In hot humid climates, the aerobic decomposition of organic matter leads to the formation of primary laterite. In cold humid climates, this aerobic decomposition of organic matter ends in the formation of podsol, or, where the water table is high (swamps), in gley. Under conditions of cold but dry climate, the climax form of rock-weathering, which also results from decomposition of organic matter, is known as black earth or chernozem. And, under hot semi-arid conditions, primary laterite changes into secondary laterite. --G. E. Denegar.

**1-360. Mackay, J. Ross. A SUBSURFACE ORGANIC LAYER ASSOCIATED WITH PERMAFROST IN THE WESTERN ARCTIC: Canada, Dept. Mines & Tech. Surveys, Geog. Branch, Paper no. 18, 21 p., 1958, 19 refs.**

The Canadian Geographical Branch has conducted studies of terrain conditions in northern Canada for many years. The present study concerns itself with a detailed study of the origin of the discontinuous subsurface organic layer lying close to the permafrost surface throughout extensive areas of the western Arctic.

These organic layers are not local phenomena, but appear to have a wide distribution in the tundra soils of the world. They are not formed as part of tundra-soil development, in the pedagogic sense, but have resulted from progressive burial of the organic tongues that extend downward in the depressions between hummocks. These organic layers develop slowly, probably over a period of thousands of years. --F. A. Cook.

**1-361.** Crook, Keith A. W. **"FINGER-PRINT" PATTERN ON CERTAIN CALCAREOUS SOILS - A SUGGESTION: Am. Assoc. Petroleum Geologists, Bull., v. 42, no. 12, p. 3001, cross-sec., Dec. 1958, 3 refs.**

"Finger-print" patterns discussed by Tanner (1958) appear to be similar to Australian "gilgai" soils which have 2 types of surface soil showing appreciable surface microrelief. This relief takes the form of sub-parallel ridges and valleys, or random mounds and depressions, or a network arrangement of ridges with enclosed depressions. The puff, or ridge, soil is calcareous; the shelf, or valley, soil is not calcareous on the surface, but its subsoil is similar to that found at the surface of the puffs. Genesis of "gilgai" soils is not well understood. Over much of the area in Australia where these soils occur, an origin by frost action is unlikely. Alternate drying and wetting may cause the observed features. --A. C. Sangree.

**1-362.** Day, Alan A. **THE CONTINENTAL MARGIN BETWEEN BRITTANY AND IRELAND: Deep-Sea Research, v. 5, no. 4, p. 245-61, 8 figs. incl. bathymetric charts, table, 1959, 38 refs.**

The continental slope between Brittany and Ireland is steep and cut by many canyons, with the exception of the central region which forms a broad smooth spur. Scarps up to 110 mi. in length are associated with the continental margin, and these, together with the steep areas of the slope proper are considered very probably to have been developed by faulting. Cores and bottom samples from the area are shown mainly to represent Recent and Pleistocene deposits, with the exception of 3 which represent Tertiary and possibly Cretaceous strata.

New names applied to topographic features in the area are: Meriadzek Terrace, Goban Spur, and Pendragon Scarp. --Auth.

**1-363.** Fay, Robert O. **PLEISTOCENE COURSE OF THE SOUTH CANADIAN RIVER IN CENTRAL WESTERN OKLAHOMA: Oklahoma Geol. Survey, Oklahoma Geology Notes, v. 19, no. 1, p. 3-12, 5 figs., Jan. 1959.**

The South Canadian River was probably initiated during the Laramide orogeny and flowed eastward upon Cretaceous rocks to the western edge of Oklahoma. It probably deposited much of the Tertiary sediments to the W. and eroded the Permian beds to the E., thus forming a valley. During the early Pleistocene epoch the valley was further deepened and filled with alluvium derived by erosion of Tertiary beds. Sometime during the middle of the Pleistocene epoch (probably late Kansan age) there is evidence that stream piracy took place, and a new channel was initiated farther E. This new channel has successive terrace levels that are matched, with gravel predominantly on the NE. side and silt and clay on the SW. side, thus showing that the channel's net shift was from the NE. to the SW., following the regional dip of the beds. The distribution of the old channel gravels and the newly formed channel gravels after piracy suggest that the stream which pirated the old South Canadian River was a southward-flowing tributary to the old South Canadian River. The old channel deposits are interbedded with the Pearlette type (late Kansan) volcanic ash, whereas the younger deposits do not contain the ash. At least 4 terrace levels of the younger deposits are present, which suggests 4 different times of cut and fill since Kansan time. The lowest level has sharp boundaries and may possibly be Wisconsinan. The next 2 may be Illinoian and the top one (or 2?) may be Kansan, pending further study. --Auth.

**1-364.** Malmström, Vincent H. **A REGIONAL GEOGRAPHY OF ICELAND: Natl. Acad. Sci.-Natl. Research Council, Pub. 584 (Div. Earth Sci., Foreign Field Research Program, Rept. no. 1), 255 p., 98 figs. incl. illus., approx. 75 maps, graphs, 51 tables, Apr. 1958, 85 refs.**

This report is intended as a comprehensive introduction to the geography of Iceland. It is based on extensive field work conducted during the summer of 1956. Techniques of gathering data included library research, interviews, and personal observation in the field. Bibliographic sources consist primarily of Icelandic publications of recent date.

The first 5 chapters (104 p.) deal with aspects of the country's physical geography; the remaining 11 (151 p.) treat individual phases of its human and economic geography. Chap. 1 describes the island's location, size and configuration, while Chap. 2 provides a sketch of the country's geologic history and outlines its major topographic regions. The relative importance of the various geomorphic agents in producing present-day landforms is discussed, and examples of specific features are cited. Chap. 3 presents a detailed examination of the various climatic controls and elements represented in Iceland. In Chap. 4 the physical character of the surrounding seas and of the surface waters on the land is surveyed, followed by a discussion of the island's soils. The biotic aspects of the environment are described in Chap. 5, and the importance of grass as a factor in the human occupance of the land is stressed.

Chaps. 6 through 15 discuss the island's settlement, demography, and economy, as well as current social and political patterns. Chap. 10 treats mineral resources and earth heat as a source of power. In the final chapter a summary and prospectus for each of the regions is given.

Little of the data contained in this report is available elsewhere in English, and much of it has been compiled and presented cartographically for the first time. --Auth.

**1-365.** Hamelin, Louis-Edmond. **LE "SERTAO" DU "NORDESTE" (BRÉSIL) - ESSAI DE DEFINITION D'UN "PAYS" [THE "SERTAO" OF THE "NORTHEAST" (BRAZIL) - ATTEMPT AT A DEFINITION OF A "PAYS" (in French, with English summ.)]: Cahiers de Géographie de Québec, année 2, no. 4, p. 241-48, 2 illus., map, Apr.-Sept. 1958, 8 refs.**

Despite the fact that Brazil is a young and vast country, some of its regions have already acquired a personality of their own. The *Sertão* in the NE. is such a case. Of triangular shape, the *Sertão* opens in the N. towards the Atlantic ocean; it covers 10% of the total area of Brazil and includes more than 90% of the states of Rio Grande do Norte, Ceara, and Paraiba.

It is a semiarid region with a dry climate, chiefly responsible for an original type of vegetation: the *caatinga*. The fundamental features of the relief are *horizontal* with depressions and inselbergs. The rare good soils are deteriorated and the hydrographic network is fair.

Such a severe country is inhabited by 7 million persons of mixed ethnic origins. The dominant occupational types, are the *vaqueiro,* the *garimpeiro,* the truck driver, and, during the dry season, the *flagellado.* It is an "under-developed" country economically, with low standards of living and a production based on food and cattle. If the *Sertão* is unsafe for foreigners, it remains for the natives a mystical and attractive country that may become more prosperous with the hydroelectric development of the São Francisco river. --Auth.

## 3. STRUCTURAL GEOLOGY

*See also*: Geologic Maps 1-296; Stratigraphy 1-378, 1-381; Geophysics 1-431.

**1-366.** Roberts, A. GEOLOGICAL STRUCTURES AND MAPS, A COURSE IN INTERPRETATION WITH APPLICATIONS FOR CIVIL & MINING ENGINEERS: 2d ed. enlarged, 92 p., 54 figs., 39 maps, London, Cleaver-Hume Press Ltd., 1958.

This general survey of the principles of geologic-map interpretation, with exercises, is supplemented by map-application techniques to civil engineering and mine surveying and development. Brief discussions of sedimentary rocks, outcrops, folds, faults, unconformities, effects of erosion, igneous rocks, and glacial deposits are given. Also included are illustrations and data on coal-seam structures; explanations of isopach maps; and information on aspects of surface geology, engineering and water-supply problems, petroliferous structures, borehole sections, and concealed coalfields. --G. E. Denegar.

**1-367.** Hubbert, M. King, and William W. Rubey. ROLE OF FLUID PRESSURE IN MECHANICS OF OVERTHRUST FAULTING. I. MECHANICS OF FLUID-FILLED POROUS SOLIDS AND ITS APPLICATION TO OVERTHRUST FAULTING: Geol. Soc. America, Bull., v. 70, no. 2, p. 115-66, 32 figs. incl. diags., graphs, 5 tables, Feb. 1959, approx. 140 refs.

Promise of resolving the paradox of overthrust faulting arises from a consideration of the influence of the pressure of interstitial fluids upon the effective stresses in rocks. If, in a porous rock filled with a fluid at pressure $p$, the normal and shear components of total stress across any given plane are $S$ and $T$, then

$$\sigma = S - p, \tag{1}$$

$$\tau = T, \tag{2}$$

are the corresponding components of the *effective* stress in the solid alone.

According to the Mohr-Coulomb law, slippage along any internal plane in the rock should occur when the shear stress along that plane reaches the critical value

$$\tau_{crit} = \tau_0 + \sigma \tan \phi \ ; \tag{3}$$

where $\sigma$ is the normal stress across the plane of slippage, $\tau_0$ the shear strength of the material when $\sigma$ is zero, and $\phi$ the angle of internal friction. However, once a fracture is started $\tau_0$ is eliminated, and further slippage results when

$$\tau_{crit} = \sigma \tan \phi = (S - p) \tan \phi \ . \tag{4}$$

This can be further simplified by expressing $p$ in terms of $S$ by means of the equation

$$p = \lambda S, \tag{5}$$

which, when introduced into equation (4), gives

$$\tau_{crit} = \sigma \tan \phi = (1 - \lambda) S \tan \phi \ . \tag{6}$$

From equations (4) and (6) it follows that, without changing the coefficient of friction tan $\phi$, the critical value of the shearing stress can be made arbitrarily small simply by increasing the fluid pressure $p$. In a horizontal block the total weight per unit area $S_{zz}$ is jointly supported by the fluid pressure $p$ and the residual solid stress $\sigma_{zz}$; as $p$ is increased, $\sigma_{zz}$ is correspondingly diminished until, as $p$ approaches the limit $S_{zz}$, or $\lambda$ approaches 1, $\sigma_{zz}$ approaches 0.

For the case of gravitational sliding, on a subaerial slope of angle $\theta$

$$T = S \tan \theta \ , \tag{7}$$

where $T$ is the total shear stress, and $S$ the total normal stress on the inclined plane. However, from equations (2) and (6)

$$T = \tau_{crit} = (1 - \ ) S \tan \phi \ . \tag{8}$$

Then, equating the right-hand terms of equations (7) and (8), we obtain

$$\tan \theta = (1 - \lambda) \tan \phi \ , \tag{9}$$

which indicates that the angle of slope $\theta$ down which the block will slide can be made to approach 0 as $\lambda$ approaches 1, corresponding to the approach of the fluid pressure $p$ to the total normal stress $S$.

Hence, given sufficiently high fluid pressures, very much longer fault blocks could be pushed over a nearly horizontal surface, or blocks under their own weight could slide down very much greater slopes than otherwise would be possible. That the requisite pressures actually do exist is attested by the increasing frequency with which pressures as great as 0.9 $S_{zz}$ are being observed in deep oil wells in various parts of the world. --Auth.

**1-368.** Rubey, William W., and M. King Hubbert. ROLE OF FLUID PRESSURE IN MECHANICS OF OVERTHRUST FAULTING. II. OVERTHRUST BELT IN GEOSYNCLINAL AREA OF WESTERN WYOMING IN LIGHT OF FLUID-PRESSURE HYPOTHESIS:

Geol. Soc. America, Bull., v. 70, no. 2, p. 167-206, 11 figs. incl. cross-secs., graphs, 4 tables, Feb. 1959, approx. 100 refs.

Pressures of interstitial fluids significantly greater than the normal hydrostatic pressure are known in many parts of the world. Many occurrences are in thick sections of relatively young sediments; some are in areas that have been intensely deformed. Abnormal fluid pressures in the Gulf Coast region are associated with thick bodies of shale or mudstone, and with high hydraulic gradients across bedding. The rocks there have been buried rather rapidly and are evidently not yet fully compacted. The mechanism by which clay consolidates under pressure affords a quantitative relationship among the variables - depth, strength of clay, and fluid pressure - and this relationship indicates that the Gulf Coast examples agree fairly well with observations on depth and porosity in Paleozoic shales of Oklahoma and Tertiary shales of Venezuela. Critical data are lacking, but permeability clearly decreases tremendously as clay rocks are compacted. This decrease in permeability provides a self-sealing mechanism that greatly retards the escape of pore water from deeply buried clay rocks. The relationship between rate of compaction and the development of abnormal fluid pressures probably applies not only to clay rocks but also to carbonates and possibly to micaceous and chloritic metamorphic rocks. Conditions of geosynclinal deposition are, in general, those most favorable to the development of abnormal fluid pressures.

The hypothesis that large-scale overthrusting is facilitated by abnormal fluid pressures which, in turn, are associated with geosynclinal deposition is applied to the overthrust belt of western Wyoming and adjacent States. This is a long curving belt of several bedding-plane faults which have an aggregate horizontal displacement across the belt of 50 mi. or more. The sedimentary rocks that make up the belt were evidently deposited in a major geosyncline bordered by uplands not far to the W. At any given locality, the rate of deposition of the sediments increased continuously until the beginning of intense deformation and overthrusting. The geosynclinal axis and the bordering uplands probably migrated slowly eastward across the belt. Several lines of indirect evidence suggest that abnormal fluid pressures developed in this region during final stages of rapid geosynclinal sinking and that thick plates of Paleozoic and Mesozoic sedimentary rocks sheared off from the underlying rocks and moved slowly eastward. Rate of movement probably was controlled by erosion of upfolds that arose at the front of each moving plate. The fundamental cause of the lateral stresses that propelled the overthrusts is not known, but it may be examined instructively in the light of the fluid-pressure hypothesis. The thrust sheets might, for example, have slid by simple gravitation down the western limb of the geosyncline on reasonable slopes and not improbable fluid pressure-overburden ratios. Such large-scale slumping of thrust sheets, however, seems to require gaps at the rear of the thrust sheets. The long intermontane valleys of Idaho and Utah may possibly have originated as such gaps or rifts, but no proof has yet been recognized that they were formed in this manner. An alternative possibility, regional compression, requires concentration of the lateral stresses within the upper few miles of the earth's crust; in this general region emplacement of the Idaho batholith seems the most likely source of such superficially concentrated stresses. However, this batholith is so far from the front edge of the overthrust belt that it would require extremely high fluid pressure-overburden ratios over a wide area. Perhaps some combination of the two forces - pushing wide thrust plates down a gentle slope - is the most likely explanation. --Auth.

1-369. Jones, K. A. A PETROFABRIC METHOD OF FOLD ANALYSIS: Am. Jour. Sci., v. 257, no. 2, p. 138-43, 2 figs., Feb. 1959, 8 refs.

A petrofabric technique of fold analysis, whereby a quartz fold is "unrolled," as applied to a simple fold by Ladurner (1954), is given in detail. The technique is applied to a more complex fold from the Dalradian of W. Perthshire, in which the degree of preferred orientation of quartz c-axes is weaker than in the fold cited by Ladurner (op. cit). It is concluded that the technique gives results allowing a clear cut interpretation only when one strong maximum occurs in the quartz diagrams. --Auth.

1-370. Jones, K. A. THE SIGNIFICANCE OF SCHNITTEFFEKT IN PETROFABRIC DIAGRAMS: Am. Jour. Sci., v. 257, no. 1, p. 55-62, 2 figs., 2 photomicrographs, Jan. 1959, 8 refs.

Peripheral girdles in petrofabric diagrams can be due entirely to the weak preferred orientation and inequidimensional shape of the minerals measured. This is termed Schnitteffekt (cut effect). A fabric analysis of a tectonite containing albite porphyroblasts with quartz inclusions shows that without thorough fabric analysis and the exercise of necessary controls, serious mistakes in interpretation can arise. Diagrams of the quartz inclusions showed similar patterns regardless of the direction in which the thin section was cut. Several controls by which mistakes due to Schnitteffekt can be avoided are suggested. --Auth.

1-371. Uffen, Robert J. ON THE ORIGIN OF ROCK MAGMA: Jour. Geophys. Research, v. 64, no. 1, p. 117-22, 5 figs., 2 tables, Jan. 1959, 17 refs.

The remarkable correlation between the locations of ocean trenches, eugeosynclines, gravity anomalies, volcanic islands, and earthquake foci suggests a common origin. These phenomena are frequently interpreted as being due to compressive failure of the outermost crust of the earth. Yoder's (1952) hypothesis has been extended to include remelting upon release of pressure during compressive failure rather than tensile failure. The range of mean pressure, and the corresponding melting ranges for likely constituents of the crust and mantle, have been estimated. This hypothesis of magma generation is quantitatively feasible, but the data, especially the actual temperature distribution, are at present inadequately known. --Auth.

1-372. Godfrey, John D. PRECAMBRIAN SHIELD STRUCTURES NORTH OF LAKE ATHABASCA, ALBERTA: Canadian Mining Jour., v. 80, no. 1, p. 57-60, 2 maps, Jan. 1959, 17 refs.

Study of aerial photographs over 3,600 sq. mi. along the margin of the Precambrian Shield in northeastern Alberta has made possible an outline of the main structural elements. The topographic expressions of these features are discussed in relation to the lithology of the Precambrian rocks and to continental glaciation. Minor complex dune formations have been noted. Scattered checks of structural elements and rock types have been possible in the course of a reconnaissance survey during the summer of 1957. --Auth.

**1-373.** Tovell, Walter M. THE DEVELOPMENT OF THE SWEETGRASS ARCH, SOUTHERN ALBERTA: Geol. Assoc. Canada, Proc., v. 10, p. 19-30, 5 struct. and isopach maps, table, Dec. 1958, 22 refs.

The Sweetgrass arch, as it can be mapped in southern Alberta, appears as a composite structure. The arch is in part a continuation northward from northern Montana of the Kevin-Sunburst dome, and in part related to a NE.-trending structure referred to as the Bow Island arch. The structural data are presented by means of structure contour and isopach maps; the evolution of the Sweetgrass arch is discussed. --Auth.

**1-374.** White, Wm. H. CORDILLERAN TECTONICS IN BRITISH COLUMBIA: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 1, p. 60-100, 14 figs. incl. 13 maps, Jan. 1959, 46 refs.

The complicated structure of British Columbia is the cumulative result of no less than 6 major orogenies since the Proterozoic. Using local names to avoid unintended identification with orogenies elsewhere, these are: (1) East Kootenay, pre-Lower Cambrian; (2) Cariboo, post-Ordovician - pre-Mississippian; (3) Cassiar, post-Upper Permian - pre-Upper Triassic; (4) Coast Range, continuing from pre-Middle Jurassic to post-Lower Cretaceous and perhaps later; (5) Rocky Mountain, Paleocene; and finally, (6) Puget orogeny, extending into modern time.

The effects of East Kootenay orogeny are preserved in Purcell strata that were greatly uplifted and mildly folded. The effects of the succeeding Cariboo orogeny are much more widespread. Eugeosynclinal strata of Proterozoic and Lower Paleozoic age from the 49th Parallel to Alaska were intensely folded, regionally metamorphosed, and extensively granitized. Later deformations have not obliterated but only modified these ancient structures. Folding, faulting, and widespread ultramafic intrusion occurred during the Cassiar orogeny.

A complicated sequence of folding, regional faulting, syntectonic sedimentation, and profound granitic intrusion marked Coast Range orogeny. The dominant NNW. structural trend was modified by 2 prominent salients convex eastward. These resemble "drag-folds" oriented to conform with a counterclockwise rotation of the entire continental margin around the N. Pacific basin.

As time went on Coast Range tectonism migrated eastward, merging insensibly into Rocky Mountain orogeny that culminated in Paleocene time. Profound crustal shortening was accomplished in the Rocky Mountain region by folding and thrust faulting.

Puget orogeny includes intermittent crustal disturbances that have continued into historic time. It is expressed by several stages of locally intense folding; fairly extensive granitic intrusion; successive uplifts and tilting in the Rockies, Cascades, and Coast Mountains; and by Upper Tertiary to Recent vulcanism. --Auth.

**1-375.** Wilson, Charles W., Jr., and Richard G. Stearns. STRUCTURE OF THE CUMBERLAND PLATEAU, TENNESSEE: Tennessee, Dept. Conserv., Div. Geol., Rept. Inv. no. 8, 14 p., 8 figs. incl. maps, secs., 1958, 28 refs.; reprinted from: Geol. Soc. America, Bull., v. 69, no. 10, p. 1283-96, Oct. 1958.

Present structure of the Cumberland Plateau results from 2 components: (1) regional eastward dip of about 25 ft. per mi. off the Cincinnati arch; and (2) Pine Mountain, Cumberland Plateau, and Sequatchie Valley bedding thrusts, which strike northeastward and have roots in the Valley and Ridge province to the SE.

Gentle eastward dip off the flank of the Cincinnati arch is the only structure affecting the undisturbed portion of the plateau, and is also the primary component of structure in the faulted area. Bedding thrusts do not disturb the position and attitude of strata within the thrust sheets. Locally, however, where the faults cut across bedding, superficial anticlines are formed. The structural concordance between the undisturbed areas and areas of bedding thrusts supports the "no-basement" interpretation for the essential regional structure.

Movement of the Cumberland Plateau overthrust sheet over steep portions of its generally flat fault plane caused superficial flat-topped, steep-sided anticlines similar to the Powell Valley anticline of the Pine Mountain overthrust. Abrupt ends of such anticlines mark places where buried steep thrusts become buried strike-slip faults.

The oldest thrust is the NW.-dipping Whetstone Mountain fault; next is the Cumberland Plateau overthrust; the youngest thrusts are the Sequatchie Valley thrust and some faults of the Valley and Ridge province. --Auth.

## 4. STRATIGRAPHY AND HISTORICAL GEOLOGY

See also: Geologic Maps 1-295, 1-307; Geomorphology 1-350; Paleontology 1-391, 1-408, 1-423; Mineral Deposits 1-506; Fuels 1-526.

**1-376.** Lowman, Paul D., Jr. AN ANALYSIS OF THE CYCLOTHEM PROBLEM: Compass, v. 36, no. 2, p. 104-13, 3 figs., Jan. 1959, 14 refs.

Various theories concerning the origin of cyclothems have been proposed, few of which take explicit cognizance of the distinction between "cyclic" and "rhythmic." Cyclothems of the Cherokee group of Kansas seem to exhibit periodicity upon analysis. Periodic oscillation may imply a feedback mechanism in the casual chain. This paper is an attempt to discover rhythm in cyclothems, to determine if such rhythm is caused by a feedback process, and to analyze existing theories of origin from the standpoint of automatic control theory. It is concluded that the focus of attention in cyclothem investigations should be not "Why cyclothems?" but "Why rhythm?." --Auth.

**1-377.** Huber, N. King. SOME ASPECTS OF THE ORIGIN OF THE IRONWOOD IRON-FORMATION OF MICHIGAN AND WISCONSIN: Econ. Geology, v. 54, no. 1, p. 82-118, 6 figs. incl. map, 11 tables, Jan.-

Feb. 1959, 53 refs.

The Ironwood iron-formation of the Gogebic Range of Michigan and Wisconsin is made up of several rock types, each of which is characterized by a different iron-rich mineral: hematite, magnetite, pyrite, iron carbonate, or iron silicate (minnesotaite, stilpnomelane). Where the Ironwood iron-formation is relatively unaltered the Plymouth, Norrie, and Anvil members consist of wavy-bedded magnetite and silicate-rich rocks, whereas the Yale and Pence members consist of even-bedded carbonate, silicate, magnetite, and pyrite-rich rocks. These rock types represent primary facies of the iron-formation that were deposited under differing physical and chemical conditions during a period of continuous iron-rich sedimentation.

Animikie sedimentation in the Gogebic district began with the deposition of sandstone and dolomitic limestone in a shallow sea advancing over a low-lying land mass of lower Precambrian granite and greenstone. Continued advance of the sea, with effective separation of clastic material near shore, permitted the dominantly chemical sedimentation of the iron-formation in somewhat deeper water. The development of an off-shore basin with partially restricted circulation would have facilitated such deposition. Minor fluctuations in the physical and chemical conditions within the depositional environment are reflected in the differing facies of the iron-formation. Deposition of the iron and silica-rich chemical sediments was terminated by increased tectonism and the deposition of the thick sequence of slates and graywackes of the Tyler formation. --Auth.

**1-378. Porter, J. W., and J. G. C. M. Fuller. LOWER PALEOZOIC ROCKS OF NORTHERN WILLISTON BASIN AND ADJACENT AREAS: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 1, p. 124-89, 23 figs. incl. geol., isopach, struct.-contour, and salinity maps and cross-secs., 2 pls. incl. 6 photomicrographs, Jan. 1959, 25 refs.**

Cambrian, Ordovician, and Silurian strata of Manitoba, Saskatchewan, northern North Dakota, and northeastern Montana comprise 2 vertically separated parts: a lower sequence of non-carbonate clastic beds ranging from Cambrian to Upper Ordovician, and an upper sequence of dolomitic limestones and dolomites ranging from Upper Ordovician to Silurian. The rocks floor all the northern part of the Williston Basin, reach more than 3,000 ft. in thickness, and are unconformably overlain by Middle Devonian or younger beds.

The formations cropping out along the northeastern side of the basin can be traced (in the form of para-time-rock units) by means of subsurface sections across the entire area. The full sequence in upward order is: Deadwood formation, Winnipeg formation; Red River, Stony Mountain, and Stonewall formations (Bighorn group); and Interlake group.

The clastic Deadwood and Winnipeg formations are separated by an unconformity of probable post-earliest Ordovician pre-Middle Ordovician age. The carbonate succession above records numerous small hiati, but no major breaks of sedimentation.

Toward the end of Red River carbonate deposition marked cyclic alternation between thin evaporitic anhydrites and fossiliferous-fragmental limestones occurred. The evaporites extend through a wide arc on the northern and western sides of the basin. Lateral (updip) changes from limestones to dense dolomites cause divergence between the marker bed and facies boundaries: lithologic features typical of the upper part of the Bighorn group appear to descend into the Red River formation toward the basin margin.

Shales at the base of the overlying Stony Mountain formation seem to be the result of slight tectonic adjustment on the southeastern side of the basin, but the carbonate-evaporite cycles returned during later Stony Mountain and Stonewall deposition. Interlake group deposits are characterized by dense dolomites with pseudo-oölitic and fragmental beds. Sedimentation was interrupted by several non-sequential beds of highly rounded quartz-sand grains and silts. These horizons are utilized as para-time-rock markers.

Isopach maps reveal a progressive movement of the axis of the basin from a nearly E.-W. trend during Red River deposition to a NNW.-SSE. trend during Interlake deposition.

Petroleum accumulations (either "shows" or producible quantities) occur at many porous levels in the succession, particularly in stratigraphic traps developed by the upper Red River and Stony Mountain-Stonewall evaporite cycles on the western side of the basin (S.-central Saskatchewan, western North Dakota, and northeastern Montana), and in paleotopographic or tectonic structures over truncated Interlake porosities at the pre-Middle Devonian unconformity. Both kinds of trap are analogous to Mississippian reservoirs and cap rocks in the northeastern part of the basin. The areal distribution of presently known oil occurrences is directly related to the distribution of highly saline formation waters. --Auth.

**1-379. Keller, B. M. SILURIYSKIYE OTLOZHENIYA POLUOSTROVA AK-KERME (OZ. BALKHASH) [SILURIAN DEPOSITS ON THE AK-KERME PENINSULA (LAKE BALKHASH)]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 2, p. 3-11, 3 illus., fig., 3 refs.**

This article summarizes the research and work of numerous geologists on the Ak-Kerme peninsula on the western banks of Lake Balkhash [46°N. 74°E.]. Many faunal and floral fossils found there facilitated the task of the explorers to determine the age of the different deposits of which this peninsula is composed. The most ancient deposits are of Ordovician and Silurian age. Various stages of these periods could have been determined by fossils. The results of all these studies will facilitate more detailed stratigraphic research on the peninsula in the future. --LC.

**1-380. Rigby, J. Keith. UPPER DEVONIAN UNCONFORMITY IN CENTRAL UTAH: Geol. Soc. America, Bull., v. 70, no. 2, p. 207-18, 3 geol. maps, 2 cross-secs., Feb. 1959, 34 refs.**

Rocks equivalent to the upper Devonian Pinyon Peak limestone and Victoria quartzite occur unconformably above older rock units in central and E.-central Utah. This unconformity is perhaps most profound in the Stansbury Range where Pinyon Peak limestone overlies rocks as old as the upper part of the Tintic quartzite and as young as Simonson dolomite. A thick conglomerate occurs below the Pinyon Peak formation at the northern end of the range, and the conglomerate rests upon rocks as young as the Laketown dolomite. To the S. the conglomerate is thin and rests upon lower Simonson dolomite.

Pinyon Peak limestone overlies Victoria quartzite which is disconformable upon Simonson dolomite.

A similar but much thicker arenaceous unit is exposed on Stansbury Island N. of the core of the uplift.

The unconformity is present in the Oquirrh and southern Wasatch Mountains where Mississippian rocks rest unconformably upon Upper and Middle Cambrian units and generally rest lower in the section from SW. to NE. Ophir shale, exposed below the Mississippian and lenticular Devonian rocks in the Central Wasatch SE. of Salt Lake City, represents an area of deep erosion. NE. of Salt Lake City, the unconformity is at the base of the Upper Devonian clastic unit within the Three Forks or Jefferson formations. Younger rocks appear beneath the unconformity toward the N.; a nearly complete and normal section occurs in the vicinity of Logan in the northeastern corner of the State.

The thick conglomerate of the Stansbury Range and the more widespread Upper Devonian sandstone, siltstone, shale, and silty carbonate units were probably derived from erosion of the uplifted area. Erosion, not nondeposition, probably accounts for much of the stratigraphic gap immediately below uppermost Devonian and lowermost Mississippian rocks in the central part of Utah. --Auth.

**1-381. Nelson, Samuel J. FAULTED RUNDLE (MISSISSIPPIAN) SECTION AT CROWSNEST PASS, ALBERTA, CANADA: Geol. Soc. America, Bull., v. 70, no. 1, p. 107-10, columnar secs., Jan. 1959, 11 refs.**

Paleontological evidence supports the notion that the anomalous 5000-ft. thickness of the Rundle group at Crowsnest Pass, just E. of the Alberta-British Columbia boundary, is caused by faulting. The Rundle is a W.-dipping, superficially undisturbed sequence of carbonates which normally attains a thickness less than 3000 ft. Five diagnostic fossil assemblages corroborate earlier lithologic studies which indicated that the succession was repeated by probably 4 faults and that the true stratigraphic thickness is about 2700 ft. --G. E. Denegar.

**1-382. Nesterenko, L. P. K METODIKE KORRELYATSII RAZREZOV NIZHNEPERMSKIKH OTLOZHENIY DONETSKOGO BASSEYNA, YEGO SEVERO-ZAPADNYKH OKRAIN I VOSTOCHNOY CHASTI DNEPROVSKO-DONETSKOY VPADINY [ON METHODS OF CORRELATION OF THE LOWER PERMIAN DEPOSITS OF THE DONETS BASIN, ITS NORTHWESTERN EDGE AND EASTERN PART OF THE DNIEPER-DONETS DEPRESSION]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 2, p. 118-22, 6 refs.**

In this article the author proposes a new stratigraphic scheme for the correlation of deposits of the Lower Permian system in different parts of the Donets basin [48°30'N. 38°30'E.], its northwestern edge, and the eastern part of the Dnieper lowland (50°N. 32°E.). --LC.

**1-383. Tozer, E. T. STRATIGRAPHY OF THE LEWES RIVER GROUP (TRIASSIC), CENTRAL LABERGE AREA, YUKON TERRITORY: Canada, Geol. Survey, Bull. 43, 28 p., illus., 3 figs. incl. geol. map and columnar sec. (in pocket), 3 pls., 1958, refs.**

In S.-central Yukon, a northwesterly-trending syncline has preserved an extensive terrain of Mesozoic sediments in an area otherwise dominated by older rocks and Mesozoic intrusions. In this region, 3 units of Mesozoic sediments are recognized: the Lewes River group (Triassic), the Laberge group (Jurassic), and the Tantalus formation (Upper Jurassic or Lower Cretaceous).

The Lewes River group has been subdivided in this report into 5 formations, designated A to G in ascending order. These are composed mainly of limestone but with some formations largely or entirely of shale and greywacke. They are all of Upper Triassic age ranging from lower Karnian(?) to upper Norian or possibly slightly younger. --H. M. A. Rice.

**1-384. Ekren, E. B., and Houser, F. N. RELATIONS OF LOWER CRETACEOUS AND UPPER JURASSIC ROCKS, FOUR CORNERS AREA, COLORADO: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 1, p. 190-201, 4 illus., fig., Jan. 1959, 16 refs.**

In many parts of the Colorado Plateau continuous conglomerate and sandstone lenses within the Burro Canyon formation (Early Cretaceous age) present a contrast to the dominantly mudstone upper part of the Morrison formation (Late Jurassic age). In the Four Corners area of southwestern Colorado, however, the lithologic character of the Burro Canyon is extremely variable, and in places the formation consists entirely of mudstone.

The mudstone of the Burro Canyon formation and mudstone of the Brushy Basin member of the Morrison formation characteristically weather differently, the mudstone of the Burro Canyon to hacky fragments and mudstone of the Brushy Basin member to a hard frothy crust. This difference is believed due to original differences in composition rather than diagenetic processes, and it was found to persist throughout southwestern Colorado.

The compensatory thickening of the Burro Canyon formation in relation to the Morrison formation, lateral change within short distances from mudstone of the Burro Canyon to mudstone of the Brushy Basin member, lack of evidence of a persistent unconformity between the Morrison and Burro Canyon, and the partial interbedding and intertonguing of the lowest conglomerate and sandstone of the Burro Canyon with mudstone of the Brushy Basin indicate that the Burro Canyon formation and Brushy Basin member of the Morrison formation are conformable and intertongue. The lack of fossil evidence prohibits precise placement of the Jurassic-Cretaceous time boundary.

The lowest conglomerate in the Burro Canyon formation is part of a system of channel-filling conglomerate and conglomeratic sandstone lenses. The name Karla Kay conglomerate member is proposed for this system of lenses.

A new sedimentary cycle accompanied by reduction in volcanic ash deposition is suggested by the Karla Kay conglomerate and adjacent mudstones of the Burro Canyon formation. The basal conglomerate of the Burro Canyon and Stokes' Buckhorn conglomerate member of the Cedar Mountain formation of central Utah may be lithogenic equivalents. The general decrease in the number of conglomerate and sandstone lenses southward in the Four Corners area of Colorado suggests that this area may be near the southern edge of deposition of the coarse clastic material of the Burro Canyon. --Auth.

**1-385. Heron, S. Duncan, Jr. HISTORY OF TERMINOLOGY AND CORRELATIONS OF THE**

BASAL CRETACEOUS FORMATIONS OF THE CAROLINAS: South Carolina, State Devel. Board, Div. Geology, Bull., v. 2, no. 11-12, p. 77-88, fold. chart, Nov.-Dec. 1958, 27 refs.

Since 1900, many attempts to describe and subdivide the Coastal Plain formations of the Carolinas have resulted in complex terminology and correlations. This report illustrates the complexity in a study of the stratigraphy of the outcropping basal Cretaceous formations between Fayetteville, North Carolina, and McBee, South Carolina.--G.E. Denegar.

1-386. Robinson, C.S., W. J. Mapel, and W. A. Cobban. PIERRE SHALE ALONG WESTERN AND NORTHERN FLANKS OF BLACK HILLS, WYOMING AND MONTANA: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 1, p. 101-23, 2 index maps, cross-sec., Jan. 1959, 7 refs.

The marine Pierre shale, of Late Cretaceous age, on the northern and western flanks of the Black Hills, consists of dark gray shale with some sandy shale and sandstone, and many beds of bentonite. It ranges in thickness from 2,000 to 2,700 ft.

In this area the Pierre shale may be divided into several members on the basis of lithologic differences in the shale and the presence of sandy and bentonitic units. In ascending order, these are the Gammon ferruginous member (including the Groat sandstone bed), the Mitten black shale member, and an unnamed upper part that consists of half or more of the formation. This upper part is chiefly dark gray shale but contains at the base a gray silty shale unit and near the top the Monument Hill and Kara bentonitic members.

Studies in progress by Cobban reveal at least 16 ammonite zones in the Pierre shale on the western flank of the Black Hills.--Auth.

Appended is selected list of fossil collections from Pierre shale, Gammon ferruginous member.

1-387. Terasmae, J. CONTRIBUTIONS TO CANADIAN PALYNOLOGY: PART I, THE USE OF PALYNOLOGICAL STUDIES IN PLEISTOCENE STRATIGRAPHY; PART II, NON-GLACIAL DEPOSITS IN THE ST. LAWRENCE LOWLANDS, QUEBEC; PART III, NON-GLACIAL DEPOSITS ALONG MISSINAIBI RIVER, ONTARIO: Canada, Geol. Survey, Bull. 46, 35 p., illus., 8 figs. (2 in pocket), pl., 1958, refs.

Part I. Pollen analysis is an important tool in correlating and dating Pleistocene sedimentary rocks. It has 2 notable advantages over macropaleontology; pollen is more generally present than the larger fossils and much more evenly distributed. Generally, it is so abundant that statistical methods may be applied, and errors due to a misleading sample or unusual local conditions are largely eliminated. A truer picture of ecological conditions can be formed.

Part II. On the basis of pollen studies supplemented with some radiocarbon dates a series of non-glacial sediments between Montreal and Quebec were recognized to be older than the oldest recognized substage of the Wisconsin and younger than Sangamon. It is named the St. Pierre interval and may represent a substage during the onset of the Wisconsin glaciation.

Part III. Buried, non-glacial deposits are exposed along rivers in the lowlands S. of James Bay. The study of the pollen contained in these beds suggests that they, like the beds discussed in Part II, are older than any known Wisconsin substage and younger than Sangamon. They are correlated with the St. Pierre interval.--H. M. A. Rice.

1-388. Aswathanarayana, U. AGE OF THE SAMARSKITE OF KISHENGARH, RAJASTHAN, INDIA: Geol. Soc. America, Bull., v. 70, no. 1, p. 111-13, 2 tables, Jan. 1959, 9 refs.

A gross discrepancy occurs among feldspar lead ages and samarskite age from the pegmatite of Bajrang mine, Kishengarh (75°02'N. 26°36'E.), although both samarskite and feldspar crystallized 580 million years ago. The feldspar, however, drew into its lattice Pb evolved in a region which, for long periods in the past, contained abnormally high concentrations of Th and low concentrations of U relative to Pb. It remained "frozen" with this abnormal Pb as there was practically no subsequent contribution of Pb from the negligible amounts of U and/or Th contained in the feldspar. The age of the samarskite indicates that the Kishengarh pegmatite is very young Precambrian or earliest Paleozoic.--G. E. Denegar.

1-389. Olson, Edwin A., and W. S. Broecker. LAMONT NATURAL RADIOCARBON MEASUREMENTS V: Am. Jour. Sci., v. 257, no. 1, p. 1-28, 7 tables, Jan. 1959, 51 refs.; also pub. as: Lamont Geol. Observatory, Contr. no. 321.

Radiocarbon age measurements for glacial material from various North American localities, and tufa samples from lake terraces, samples indicating relative sea-level changes, ocean sediments, archeologic samples, and other samples from North and South America, Africa, Atlantic Ocean, Caribbean, Mediterranean, Europe and Pacific Islands measured between Feb. 1957 and July 1958 are recorded. Age calculations, new methods of chemical pre-treatment designed to detect and overcome possible sample contamination, and the effect of material type on the reliability of radiocarbon dating are discussed.--G. E. Denegar.

## 5. PALEONTOLOGY

See also: Areal and Regional Geology 1-342; Stratigraphy 1-386, 1-387.

1-390. Connell, James F. L. A WORKBOOK FOR INVERTEBRATE PALEONTOLOGY, PARTS I AND II: 2 v.: 92 p., 106 p., 103 pls., Dubuque, Iowa, Wm. C. Brown Co., 1958, 5 refs.

Pt. I, Protozoa through Echinodermata, including a chapter on fossil preservation, and Pt. II, Bryozoa through Arthropoda, outline student exercises in elementary systematic invertebrate paleontology. Nomenclature and classification schemes follow the standard systems found in Shimer and Shrock, *Index Fossils of North America*. Definitions of paleontological terminology are given, as well as brief descriptive notes. Space is given for student sketches. --G. E. Denegar.

1-391. Ladd, Harry S. ECOLOGY, PALEONTOLOGY, AND STRATIGRAPHY: Science, v. 129, no. 3341, p. 69-78, illus., map, secs., Jan. 9, 1959, 69 refs.

Ecological studies of the distribution of living assemblages in the existing seas are being applied to the interpretation of fossil faunas. Oceanographic investigations of turbidity currents are shown to have ecological aspects that bear directly on paleontology and stratigraphy, and critical data from submarine cores have been applied to sediments outcropping on the land. Ecological studies of catastrophic death in the existing seas aid interpretations of layers of sediments that are crowded with fossils. More efficient methods of trawling, dredging, and bottom sampling have shown that life in the deep sea is more widespread than previously; manned dives in the bathyscaphe have now exceeded 13,000 ft., and methods of taking underwater photographs have been greatly improved. Studies of carbonate deposition in shallow waters are being applied to interpretations of ancient reefs and other carbonate deposits. Biochemical studies of Recent and fossil shells have led to determinations of past temperatures and may result in determinations of past salinities. Improved methods of sampling in the sea have resulted in cores extending down into the Tertiary. There is reason to believe that eventually the entire section of sediments beneath the deep sea may be reached by the drill. --Auth.

1-392. Greggs, Robert G. ARCHAEOCYATHA FROM THE COLVILLE AND SALMO AREAS OF WASHINGTON AND BRITISH COLUMBIA: Jour. Paleontology, v. 33, no. 1, p. 63-75, 4 pls., Jan. 1959.

In 1948 and 1950 Dr. H. Little of the Geological Survey of Canada collected Archaeocyatha from the Lower Cambrian outcrops of Colville, Washington, and Salmo, British Columbia. These collections were later supplemented by Dr. V. J. Okulitch with fossils from the same localities.

The Archaeocyatha of the Salmo area occur in a narrow band of limestone in the basal Laib formation. Those of the Colville area, Washington, were found in an outcrop of Old Dominion limestone. Numerous species are present in both localities, and 2 new species are described: Ethmophyllum lineatus from the Laib formation and Syringocnema colvillensis from the Old Dominion limestone.

The species Archaeopharetra typica, Monocyathus sp., and Claruscyathus solidus are reported for the first time from North America. Claruscyathus solidus is particularly abundant at the Colville locality. --Auth.

1-393. Cranswick, J. Stuart, and Madeleine A. Fritz. CORAL FAUNA OF THE UPPER ABITIBI RIVER LIMESTONE: Geol. Assoc. Canada, Proc., v. 10, p. 31-81, 6 pls. incl. photomicrographs, Dec. 1958, 81 refs.

Twenty-eight species are described of which 3 are new and 2 represent hitherto unrecognized varieties. Twelve species belong to the Tetracoralla and 16 to the Tabulata. The fauna, which is considered to be of Middle Devonian age, is correlated with the ' Columbus ' of Ontario, S. of the Findley axis and central Ohio, and with the 'Jeffersonville' of SE. Indiana. --Auth.

1-394. Middleton, Gerard V. DEVONIAN TETRACORALS FROM SOUTH DEVONSHIRE, ENGLAND: Jour. Paleontology, v. 33, no. 1, p. 138-60, 6 figs., pl., Jan. 1959.

This paper described the tetracoral fauna of several masses of limestone of Middle and Upper Devonian age. The fauna consists mainly of Ancanthophyllid, Stringophyllid and Disphyllid corals. Cystiphyllid corals were also abundant, but are not described in this paper. --Auth.

1-395. Watkins, J. Lloyd. ON THE IDENTITY OF THE DEVONIAN RUGOSE CORAL GENUS DIVERSOPHYLLUM WITH TABULOPHYLLUM, AND NOTES ON THE GENUS CHARACTOPHYLLUM: Jour. Paleontology, v. 33, no. 1, p. 81-82, pl., Jan. 1959.

The Devonian rugose coral genus Diversophyllum is placed in synonymy with Tabulophyllum. Characters of the poorly understood genus Charactophyllum are described and illustrated. --Auth.

1-396. Langenheim, R. L., Jr., and V. A. McCutcheon. BAYHAIUM MERRIAMORUM, A NEW PERMIAN TABULATE CORAL FROM CALIFORNIA: Jour. Paleontology, v. 33, no. 1, p. 99-102, pl., Jan. 1959.

Bayhaium merriamorum, n. gen., n. sp., is described from the lower and middle McCloud limestone, Wolfcampian of Shasta County, California. Bayhaium is referred to the Syringoporinae although it is also morphologically related to the Syringophyllinae and Pachyporinae. --Auth.

1-397. Burckle, Lloyd H. A NEW MISSISSIPPIAN ARCHIMEDES FROM CENTRAL UTAH: Compass, v. 36, no. 2, p. 126-29, pl., Jan. 1959, 3 refs.

A new bryozoan, Archimedes bentleyi, is described from the lower part of the Manning Canyon shale (Mississippian-Pennsylvanian) in Utah County, Utah. The similarity of forms from the Warsaw-Keokuk of the mid-continent is also pointed out. --Auth.

1-398. Boucot, Arthur J. A NEW FAMILY AND GENUS OF SILURIAN ORTHOTETACID BRACHIOPODS: Jour. Paleontology, v. 33, no. 1, p. 25-28, fig., pl., Jan. 1959.

Study of Silurian and Devonian orthotetacid brachiopods from northern Maine has brought into question the proper generic identity of specimens usually referred to Fardenia in the Silurian of North America and Europe. Study of the Silurian material demonstrated that most specimens belong to a previously undescribed genus, Chilidiopsis, here assigned to a new family, which is generically distinct from Fardenia though probably derived from it.

Study of the collections in the U. S. National Museum suggests that the new genus described below is the commonest orthotetacid in the Silurian of North America and western Europe, but that Schellwienella-like forms also occur with it. Schellwienella-like forms are rare in the Silurian but are more abundant in rocks of post-Silurian age.

The type species of the new genus, "Fardenia" reedsi Amsden, 1951, is well illustrated by Amsden (1951); "Schuchertella" roemeri Foreste, 1909, here assigned to the new genus, is also well illustrated by Amsden (1949). The reader is referred to these papers for additional illustrations of the new genus. --Auth.

1-399. Boucot, Arthur J. EARLY DEVONIAN AMBOCOELIINAE (BRACHIOPODA): Jour. Paleontology, v. 33, no. 1, p. 16-24, 2 pls., Jan. 1959.

The rare ambocoeliinid genus Metaplasia Hall & Clarke, 1893, occurs only in North America. A new ambocoeliinid genus, Plicoplasia, occurs in North America, South America, and South Africa. Plicoplasia is notable for the development of strong radial plications, a feature absent in most genera belonging to the Ambocoeliinae. Metaplasia is closely related to Ambocoelia, but the presence of a low fold and low lateral plications on the brachial valve of the former serves to distinguish the 2 genera. Both Metaplasia and Plicoplasia are known from strata of Siegen to Ems age ( = Oriskany to Onondaga age), and could conceivably have been derived from the earliest Lower Devonian species of Ambocoelia described by Kozlowski (1929) from Podolia. Ambocoelia is also known in the late Lower Devonian of Czechoslovakia and Bolivia. A spinoise, weakly plicate new ambocoeliinid genus, Spinoplasia, has been recognized in strata of Gedinnian (= New Scotland) age in Gaspé. --Auth.

1-400. Olsson, Axel A., and Thomas L. McGinty. RECENT MARINE MOLLUSKS FROM THE CARIBBEAN COAST OF PANAMA WITH THE DESCRIPTION OF SOME NEW GENERA AND SPECIES: Bulls. Am. Paleontology, v. 38, no. 177, p. 1-58, 5 figs., 5 pls., Dec. 1958, 7 refs.

Recent marine mollusks along the Caribbean coast of Panama have received little study. In this paper, about 534 species and subspecies are recorded, mostly from the Island of Bocas del Toro near the northwestern corner of the Republic. Of this number about 33 forms are described as new species or new subspecies, with 4 new genera or subgenera. The material was obtained by shore collecting or by the picking of beach drift, carefully selected in the field. The main part of the Bocas collections was made in March 1953, supplemented by material obtained by the senior author in 1917 and 1920. The expense of the field work in 1953 was partly defrayed by a grant from the American Philosophical Society. --Auth.

1-401. Tseysler, V. M. SVERLYASHCHIYE MOLLYUSKI IZ ALBSKIKH OTLOZHENIY KRYMA [BORING MOLLUSKS IN ALBIAN DEPOSITS OF THE CRIMEAN PENINSULA]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 132-33, 2 illus., 1958.

A brief description of the activities of numerous Albian boring mollusks (Lithodomus), found on the eroded surface of Kimeridgian-Tithonian limestones in the valley of the Chernaya river (44°36'N. 33° 35'E.) of the Crimean peninsula. --LC.

1-402. Oleksyshyn, John. SOME NEW SPECIES OF MIOCENE MOLLUSCA FROM MARYLAND: Jour. Paleontology, v. 33, no. 1, p. 29-32, pl., Jan. 1959.

Turritella calvertensis, n. sp., T. calvertensis marylandica, n. subsp., T. calvertensis plumpointensis, n. subsp., and T. indenta chesapeakensis, n. subsp., are described from the Calvert formation of the Chesapeake Bay region, Maryland; Turritella variabilis chancellorensis, n. subsp., and Cerastoderma chancellorensis, n. sp., from the St. Mary's formation at St. Mary's City, Maryland. --Auth.

1-403. Philip, G. M., and J. A. Talent. THE GASTEROPOD GENERA LIOMPHALUS CHAPMAN AND SCALAETROCHUS ETHERIDGE: Jour. Paleontology, v. 33, no. 1, p. 50-54, fig., 2 pls., Jan. 1959.

The type species of Liomphalus Chapman, 1916, and Scalaetrochus Etheridge, 1890, are re-investigated on the basis of topotype material from the Lilydale limestone (Lower Devonian) of Victoria. Liomphalus, generally regarded as a synonym of Lytospira Koken, 1896, is shown to be a synonym of Euomphalus Sowerby, 1814, as it is based on internal moulds of Straparolus (Euomphalus) northi (Etheridge, 1890). Trochus (Scalaetrochus) lindströmi Etheridge, 1890, the type species of Scalaetrochus Etheridge, 1890, is shown to possess a variably callus-filled umbilicus and is not anomphalous as has been presumed. Thus, Siluriphorus Cossmann, 1918, should probably be regarded as a junior synonym of Scalaetrochus. --Auth.

1-404. Sweet, Walter C. ORDOVICIAN AND SILURIAN CYRTOGOMPHOCERATIDAE (NAUTILOIDEA) FROM THE OSLO REGION, NORWAY: Jour. Paleontology, v. 33, no. 1, p. 55-62, fig., 2 pls., Jan. 1959.

Two species of discosorinid nautiloids, Cyrtogomphoceras sp. cf. C. thompsoni Miller & Furnish, and Parryoceras strandi, n. sp., are illustrated and described from the Upper Ordovician of the Oslo region, Norway. Two additional nautiloids from the Norwegian Lower Silurian represent a new genus and species of Cyrtogomphoceratidae, for which the name Konglungenoceras norvegicum is proposed. Neither Cyrtogomphoceras nor Parryoceras has previously been reported with certainty from Europe; in addition, the Cyrtogomphoceras exhibits endocones in the siphuncle, structures not heretofore known to occur in the Cyrtogomphoceratidae. Konglungenoceras is like the phragmoceratid Protophragmoceras externally, but similar to advanced Cyrtogomphoceratidae internally. It may represent an unrecognized discosorinid family, perhaps including the Devonian genus, Alpenoceras. --Auth.

1-405. Imlay, Ralph W. NEW GENERA OF EARLY CRETACEOUS (ALBIAN) AMMONITES FROM ALASKA: Jour. Paleontology, v. 33, no. 1, p. 179-85, 2 pls., Jan. 1959.

New genera and species of Albian ammonites from Alaska include Moffites robustus Imlay, Freboldiceras singulare Imlay, Kennicottia bifurcata Imlay, and Parasilesites bullatus Imlay. The new species of Moffites and Kennicottia are associated with Leconteites deansii (Whiteaves) and are of early Albian age. The new species of Freboldiceras is associated with Beudanticeras glabrum (Whiteaves) and Lemuroceras sp. aff. L. indicum (Spath) and is probably of early Albian age. The new species of Parasilesites is associated with Brewericeras breweri (Gabb), Cleoniceras sp., Valdedorsella sp., Hulenites sp., and Lemuroceras (Subarcthoplites) sp. aff. L. belli McLearn. This faunule is either early Albian or early middle Albian in age. --Auth.

1-406. Murphy, Michael A., and Peter U. Rodda. NEW AMMONITES FROM THE ALBIAN OF NORTHERN CALIFORNIA: Jour. Paleontology, v. 33, no. 1, p. 103-105, 5 figs., pl., Jan. 1959.

Two species of ammonites, which are relatively abundant and are zonal indices, are described in order that the names may be used in stratigraphic discussions of the Albian rocks of northern California. --Auth.

1-407. Bright, Robert C. A PALEOECOLOGIC AND BIOMETRIC STUDY OF THE MIDDLE CAMBRIAN TRILOBITE ELRATHIA KINGII (MEEK): Jour. Paleontology, v. 33, no. 1, p. 83-98, 8 figs., 2 pls., Jan. 1959.

This paper presents the results of a study of 339 complete specimens of the Middle Cambrian trilobite Elrathia kingii (Meek) from the Wheeler formation. The following descriptive addenda were noted: (1) granulosity is variable within the species, (2) the normal number of thoracic segments in adults is 13, but may vary from 10 to 13, (3) the pygidium has only 4 axial segments, and (4) the proximal thoracic "nodes" noted by Meek proved not to be part of the thoracic segment structure but secondary features resulting from a fracture along an inherently weak zone at the dorsal furrow.

Almost all the specimens have fibrous calcite incrustations on their ventral surface. A study of this unique preservation shows the cone-in-cone nature of the calcite and that its formation was partly controlled by the fossil carapace. Suggestions as to the origin of the calcite and its structure are noted.

Reconstruction of the Wheeler environment based on faunal and lithologic evidence indicates one of moderately shallow ( <600') calm water below wave base.

The single species is treated statistically in detail. Various structural relationships were plotted graphically and the appropriate data computed. The use of simple ratios as a taxonomic and descriptive tool is discussed and evidence presented to indicate that they are adequately utilized only when considered in light of total life of the trilobite plus their variance. --Auth.

1-408. Berg, Robert R., and Reuben James Ross, Jr. TRILOBITES FROM THE PEERLESS AND MANITOU FORMATIONS, COLORADO: Jour. Paleontology, v. 33, no. 1, p. 106-19, 2 figs., 2 pls., Jan. 1959.

An Upper Cambrian fauna of Franconian age is present in the Peerless formation in a unit of sandy glauconitic dolomite that formerly was called the Ute Pass dolomite. This fauna includes species of Idahoia, Ellipsocephaloides, and Ptychaspis. The overlying Manitou formation contains in its basal portion species of 4 lowermost Ordovician zones of Utah: the B, C, D, and E or F zones. Sixteen species are described, 2 of which are new. Distribution of the zones suggests that the Manitou formation is older in the N. part of the outcrop area and overlaps the truncated Upper Cambrian rocks from N. to S. --Auth.

1-409. Hotton, Nicholas, III. ACROPLOUS VORAX, A NEW AND UNUSUAL LABYRINTHODONT AMPHIBIAN FROM THE KANSAS PERMIAN: Jour. Paleontology, v. 33, no. 1, p. 161-78, 5 figs., pl., Jan. 1959.

An excellently preserved trimerorhachoid amphibian from the middle Wolfcamp of Kansas is described, and is made the type of a new genus Acroplous, as A. vorax, n. sp. In both its morphology and its temporal occurrence the animal serves as a link between the Pennsylvanian genera Pelion and Saurerpeton and the Permian genera Eobrachyops and Trimerorhachis. Certain fossil amphibian remains from the Appalachian region, described as Saurerpeton obtusum, are referred to Acroplous.

Position of external nares and shape of skull afford room for conjecture about the habits of Acroplous. Its geological occurrence is discussed and compared with that of its Texas contemporaries. --Auth.

1-410. Todd, Ruth. RECENT LITERATURE ON THE FORAMINIFERA: Cushman Foundation for Foraminiferal Research, Contr., v. 10, pt. 1, p. 21-24, Jan. 1959.

Seventy-three briefly annotated references are given, arranged alphabetically by author. References are world-wide and are from the period 1956-1958. --A. C. Sangree.

1-411. Belford, D. J. NUTTALLINELLA, NEW NAME FOR NUTTALLINA BELFORD, 1958 (NON NUTTALLINA DALL, 1871): Cushman Foundation for Foraminiferal Research: v. 10, pt. 1, no. 195, p. 20, Jan. 1959.

Dr. Hans E. Thalmann has informed the writer that Nuttallina Belford, 1958, with type species Nuttallina coronula Belford, is preoccupied by Nuttallina Dall, 1871, for a molluscan genus. The following new name is therefore proposed:

Nuttallinella, new name, for Nuttallina Belford, 1958, Contrib. Cushman Found. Foram. Research, vol. IX, pt. 4, p. 93, non Nuttallina Dall, 1871, Amer. Jour. Conchology, vol. VII, p. 135. --Complete text of paper.

1-412. Blackmon, Paul D., and Ruth Todd. MINERALOGY OF SOME FORAMINIFERA AS RELATED TO THEIR CLASSIFICATION AND ECOLOGY: Jour. Paleontology, v. 33, no. 1, p. 1-15, fig., 4 tables, Jan. 1959.

Evidence from previous and present studies indicates that the mineralogical nature of secreted calcareous shells of Foraminifera is principally a genetic characteristic. Mineral content is probably affected, but not determined entirely, by environmental influences. Most genera are wholly calcitic. Relatively few genera are wholly aragonitic and they probably belong to 2 closely related families.

X-ray diffraction studies of 131 genera, having calcareous shells, in 29 families of Recent Foraminifera have shown varying amounts of Mg substitution for Ca in their shells. Certain of the calcitic shells are consistently characterized by low Mg content (0-5 mol % $MgCO_3$ [or 0-4.3 weight %]) and others consistently characterized by high Mg content (10. mol % or higher $MgCO_3$ [8.6 weight %]); relatively few fall into the intermediate group. A natural division of the genera of Foraminifera, related to Mg content, is indicated.

With certain few exceptions, calcitic genera whose shells have high Mg content are restricted to 12 families and those whose shells have low Mg content are restricted to 10 other families. Two families seem to belong in an intermediate group. Shells from 2 families are aragonitic in nature, hence are very low ( < 1%) in Mg content, a characteristic inherent in aragonitic-shelled organisms. Three families have both high and low Mg shells.

That the mineralogy of the shells is not strictly a function of ecology is indicated by the occurrence of both high and low Mg content types under identical environmental conditions. In addition certain genera with Mg content of as high as 10 mol % flourish under arctic conditions, where low temperatures generally result in low Mg content in other calcareous invertebrates. However, deviations to intermediate or low Mg content occur in a few genera in families whose other genera have high Mg. This deviation indicates that phylogenetic position may not be the only factor determining mineral content. Some depression of Mg substitution probably results from the low temperature of arctic or very deep tropical waters. The instances of deviation to high Mg in genera of families whose other genera are low are interpreted as an indication that the genera concerned may be suspect as to their correct taxonomic placement.

The determination of Mg content in individual Foraminifera may serve several purposes. First, it may be used as an aid in classification. Second, when the normal Mg content is known for a generic or family group, it may be an aid in determining the original environmental conditions of the living organism. Third, the varying percentages of Mg in carbonate sediments may result from the types of predominant Foraminifera present. --Auth.

1-413. Burma, Benjamin H. STATUS OF THE GENERA *HEDBERGINA* AND *HEDBERGELLA*: Cushman Foundation for Foraminiferal Research, Contr., v. 10, pt. 1, no. 193, p. 15, Jan. 1959, 2 refs.

In a recent issue of this journal, Ruth Todd (1958), in her very useful literature review, listed a paper by Brönnimann and Brown (1958). In her annotation covering their article she states: "*Hedbergella* (type species *Anomalina lorneiana* var. *trocoidea* Gandolfi), a new name for *Hedbergina*." Because Miss Todd's review is so widely read and esteemed, and because Brönnimann and Brown's paper is in a less widely circulated journal, I feel a comment on the status of these two genera should be made.

Due to the unfortunate wording of the title of their paper ("*Hedbergella*, a new name for a Cretaceous planktonic foraminiferal genus") and also a similar sentence ending (p. 15) ". . . and for which we now propose the new name *Hedbergella*.", it would readily be supposed that Brönnimann and Brown were indeed replacing the genus *Hedbergina* with *Hedbergella*. However, this could not be done. *Hedbergina* was validly named, with an originally designated type species in good standing, which Brönnimann and Brown (p. 15) specifically recognize, ". . . *G. seminolensis* . . . was originally, though inadvertently, designated the type species of *Hedbergina*; and for this reason the designation is binding and must be followed." They then proceed to erect, in fact, a new genus, *Hedbergella*, with a properly designated type species different from that of *Hedbergina*. Both genera are thus nomenclatorially valid, and one is not intended as a replacement of the other. --Complete text of paper.

1-414. Cole, W. Storrs. *ASTEROCYCLINA* FROM A PACIFIC SEAMOUNT: Cushman Foundation for Foraminiferal Research, Contr., v. 10, pt. 1, no. 192, p. 10-14, 3 pls., 6 tables, Jan. 1959, 7 refs.

Specimens of *Asterocyclina* found in "boulders" dredged from the side of a seamount near the Tuamotu Islands, French Oceania, are described and illustrated. One suite of specimens is assigned to *Asterocyclina penuria* Cole, known previously from New Caledonia, Soemba, Saipan Island, Guam Island, and the Eniwetok drill holes in the upper Eocene, Tertiary *b*. Associated specimens of *Asterocyclina* are described as a new species. No other larger Foraminifera were recovered from these sediments. --Auth.

1-415. Cole, W. Storrs. NAMES OF AND VARIATION IN CERTAIN AMERICAN LARGER FORAMINIFERA, PARTICULARLY THE DISCOCYCLINIDS - NO. 3: Bulls. Am. Paleontology, v. 38, no. 176, p. 411-29, 4 pls., Nov. 1958, 17 refs.

Discocyclinids found in the Orocopia Mountains of southern California are discussed and illustrated. The names of and variation in the 2 species to which these specimens are assigned are analyzed. In addition, another Californian species, *Pseudophragmina (Proporocyclina) clarki* (Cushman), is considered. The species of the subgenus *Proporocyclina* are analyzed and keys to the valid species are given. --Auth.

1-416. Colom, Guillermo. *GYMNESINA GLOMEROSA*, N. GEN., N. SP. (FAM. OPHTHALMIDIIDAE) FROM THE MEDITERRANEAN: Cushman Foundation for Foraminiferal Research, Contr., v. 10, pt. 1, no. 194, p. 16-19, 2 pls., Jan. 1959.

A new genus of the Ophthalmidiidae with an agglutinated test is described from the Mediterranean Sea. --Auth.

1-417. Hofker, J. ON THE SPLITTING OF *GLOBIGERINA*: Cushman Foundation for Foraminiferal Research, Contr., v. 10, pt. 1, no. 191, p. 1-9, 25 figs., Jan. 1959, 12 refs.

*Candeina* and *Sphaeroidina* are analyzed as to the inner structure of their initial chambers. Together with *Globigerinatella* they make up a group which forms a planktonic series of species derived from *Cassidulina* ancestors. The genus *Globigerinella* cannot be maintained since *G. aspera* forms a continuous development series from trochoidal forms through typical *G. aspera* towards the *Biglobigerinella* group. Such a gradational development series cannot be divided into 3 different genera. In *Globigerinoides* the same process of the division of the aperture into several smaller apertures is followed. There seems no real reason to separate *Globigerinoides* from *Globigerina*. *Catapsydrax* is shown to be a reproductive stage of other globigerines from the *Globigerina venezuelana* group. *Globigerinita* also is a reproductive stage in the development of globigerines with the structure of the *Globigerina bulloides* group. *Globigerinoita* is the reproductive stage of the *Globigerina rubra* group. *Orbulina* and *Candorbulina* are also reproductive stages of other globigerines, especially those belonging to forms in the *triloba* group. All these genera have no taxonomic value in a natural system of the Foraminifera and thus must be abandoned. --Auth.

1-418. Foreman, Helen P. A NEW OCCURRENCE OF DEVONIAN RADIOLARIA IN CALCAREOUS CONCRETIONS OF THE HURON MEMBER OF THE OHIO SHALE: Jour. Paleontology, v. 33, no. 1, p. 76-80, fig., pl., Jan. 1959.

A new occurrence of well-preserved Devonian Radiolaria in calcareous concretions of the Huron member of the Ohio shale is described. The Radiolaria, consisting primarily of Spumellina with some Nassellina present, are compared with other known Devonian radiolarian assemblages. --Auth.

1-419. Gutschick, Raymond C. LOWER MISSISSIPPIAN HOLOTHURIAN SCLERITES FROM THE ROCKFORD LIMESTONE OF NORTHERN INDIANA: Jour. Paleontology, v. 33, no. 1, p. 130-37, 6 figs., 2 pls., Jan. 1959.

Study of more than 500 holothurian sclerites from water-washed shales in the Lower Mississippian Rockford limestone formation of Jasper County, Indiana, reveals 4 genera and 10 species of which the following 4 species are new: *Thuroholia spicatus*, *Achistrum brevis*, *Microantyx botoni*, and *Rota campbelli*. The fauna bears resemblance to holothurian remains from the Lower Mississippian Escabrosa limestone of southern Arizona and the Lower Carboniferous of Scotland. --Auth.

1-420. Sylvester, Robert K. SCOLECODONTS FROM CENTRAL MISSOURI: Jour. Paleontology, v. 33, no. 1, p. 33-49, 3 figs., 2 pls., Jan. 1959.

Twenty-seven species of scolecodonts, 7 of which are new, are described from the Upper Devonian Snyder Creek and the Lower Mississippian Chouteau formations of central Missouri. The schematic arrangement of the fossil groups of a nearly complete jaw apparatus illustrates its similarity to the recent annelid counterparts. Every major type of maxillary position is figured and described, and a standardized system of terminology is presented. Although no genus of scolecodonts is confined to one geologic period, Ordovician, Silurian, Devonian, and Mississippian groups can be differentiated on the basis of specific characters. The stratigraphic ranges of 7 genera and 10 species have been extended into the Mississippian as a result of this investigation. --Auth.

1-421. Brown, Roland W. SOME PALEOBOTANICAL PROBLEMATICA: Jour. Paleontology, v. 33, no. 1, p. 120-24, pl., Jan. 1959.

Problematica encountered by paleobotanists include objects of 2 kinds: those clearly belonging to the plant kingdom but temporarily unclassifiable, and those whose identity is more doubtful, often raising questions as to whether or not they are of plant, animal, inorganic, or even artifical origin. Two such specimens, one from Eocene and the other from Miocene strata, are discussed here in the hope of receiving helpful suggestions toward their identification. Another, the supposed Eocene cactus, *Eopuntia douglassi* Chaney, from the Green River formation, is here considered to be misidentified for the tuberous rootstock of a sedge, *Cyperus filiferus* (Cockerell) Brown, n. comb. --Auth.

1-422. Wood, R. D. GAMETANGIAL CONSTANTS OF EXTANT CHAROPHYTA FOR USE IN MICROPALEOBOTANY: Jour. Paleontology, v. 33, no. 1, p. 185-94, Jan. 1959.

Descriptive data on extant species of Charophytes have been compiled, and from [the compilation] are presented 4 tables for use in identifying fossils. In the tables, the species are arranged by increasing quantitative value of (1) maximum oogonium length, (2) maximum number of oogonial convolutions, (3) maximum oospore length, and (4) maximum number of oospore striae. They are intended to assist workers in reducing the number of possibilities in specific determinations to a relatively small number, thus reducing the burden of identification. The tables should be useful to micropaleobotanists and phycologists alike. --Auth.

1-423. Colquhoun, D. J. STRATIGRAPHY AND PALAEONTOLOGY OF THE NIPISSING-DEUX RIVIÈRES OUTLIERS: Geol. Assoc. Canada, Proc., v. 10, p. 83-93, map, 4 tables, Dec. 1958, 8 refs.

Ordovician exposures of limited extent occur in Ontario on the Manitou Islands in Lake Nipissing; near Nipissing Village on the mainland S. of Lake Nipissing; and along the Ottawa River near Deux Rivières. The stratigraphy and palaeontology of these 3 areas are described, and detailed fossil lists are included. The material was collected by Professor Madeleine A. Fritz in the summers of 1954 and 1955, during the tenure of a grant from the Advisory Committee on Scientific Research at the University of Toronto. The writer revisited the area in the fall of 1955 and added further collections. --Auth.

1-424. Brown, Roland W. A BAT AND SOME PLANTS FROM THE UPPER OLIGOCENE OF OREGON: Jour. Paleontology, v. 33, no. 1, p. 125-29, pl., Jan. 1959.

Remains of a bat, not further identified, in strata at Fossil, are here added to the sparse vertebrate fauna reported from the lower (upper Oligocene) part of the John Day formation of N.-central Oregon. These and correlative beds, however, have yielded a notable flora, listed here by genera as a composite. Some of its constituents, because of their nomenclatural, stratigraphic, and floral significance, receive special comment. --Auth.

## 6. GEOPHYSICS

See also: Geologic Maps 1-303, 1-304, 1-305; Fuels 1-518, 1-523; Engineering Geology 1-537.

1-425. U. S. Library of Congress, Sci. & Technology Div. AN INTERIM BIBLIOGRAPHY ON THE INTERNATIONAL GEOPHYSICAL YEAR. A JOINT PROJECT OF THE LIBRARY OF CONGRESS, THE NATIONAL ACADEMY OF SCIENCES [AND] THE NATIONAL SCIENCE FOUNDATION: 56 p., Washington, D.C., National Academy of Sciences, 1958.

This annotated bibliography comprises 704 references published between Jan. 1951 and Aug. 1958. References are classified under the following subjects: Antarctic; Arctic; aurora and airglow; cosmic rays; geomagnetism; glaciology; gravity; ionospheric physics; longitudes and latitudes; meteor studies; meteorology; oceanography; rockets; satellites--USSR; satellites--U.S.; seismology; solar activity;

world days, warnings, and alerts; and general. --G. E. Denegar.

1-426. Odishaw, Hugh. INTERNATIONAL GEOPHYSICAL YEAR: Science, v. 128, no. 3339, p. 1599-1609, Dec. 1958; v. 129, no. 3340, p. 14-25, 14 illus., 4 figs., table, Jan. 1959, 6 refs.

Part I of a two-part summary of IGY activities briefly notes findings in areas of the upper atmosphere and the sun. Subjects treated are solar activity, aurora, cosmic rays, geomagnetism, ionospheric physics, and rockets and satellites. Part II is concerned with areas of heat and water regimen: data on atmospheric circulation patterns, particularly in the Antarctic area and in high altitudes by means of balloon soundings; information on sea-level changes, oceanic-water budget, water-current systems, marine topography; observations of valley glaciers and Greenland and Antarctic ice sheets. Also summarized are seismological studies of the earth's crust and interior, Antarctic ice-thickness measurements, standardization for calibration of gravimeters and for international datum control, longitude and latitude determinations. Status of data flow is also outlined. --G. E. Denegar.

1-427. Patrick, Homer G. GEOPHYSICAL ACTIVITY IN 1957: Geophysics, v. 23, no. 5, p. 953-71, graphs, tables, Dec. 1958.

Worldwide activity in geophysical exploration by the petroleum industry decreased slightly in 1957; gains in the Eastern Hemisphere did not fully offset the decline in the Western Hemisphere. According to reliable data received, an average of 1,122 crews of all types were active in 1957, as against 1,136 in 1956 (a record year) and 1,119 in 1955. Statistics for the world and for the United States and Canada are presented in tables and graphs. --D. B. Vitaliano. (courtesy Geophysical Abstracts, 176).

1-428. Fischer, Irene. THE IMPACT OF THE ICE AGE ON THE PRESENT FORM OF THE GEOID: Jour. Geophys. Research, v. 64, no. 1, p. 85-87, map, Jan. 1959, 11 refs.

The shape of the geoid in North America and Fennoscandia shows a remarkable correlation with the extent of Pleistocene glaciation in these areas. --Auth.

1-429. Fischer, Irene. A TENTATIVE WORLD DATUM FROM GEOIDAL HEIGHTS BASED ON THE HOUGH ELLIPSOID AND THE COLUMBUS GEOID: Jour. Geophys. Research, v. 64, no. 1, p. 73-84, 14 figs. incl. index map and geoid-contour maps, Jan. 1959, 15 refs.

From all astro-geodetic material available at present, geoidal heights were computed on the 1927 North American Datum for the western hemisphere from Canada to Chile, and on the European Datum for the eastern hemisphere from Great Britain to Japan and from Scandinavia to South Africa. Improved reference ellipsoids were determined under various conditions for each hemisphere by the least squares method. Triaxiality is refuted. The Columbus Geoid, gravimetrically derived by W. A. Heiskanen, was used to connect the astro-geodetic systems of the 2 hemispheres. By minimizing the differences between the astro-geodetic and gravimetric geoid elevations at 75 points in the western hemisphere and 127 points in the eastern hemisphere, a theoretically absolute orientation based on the Hough ellipsoid was determined, leading to a tentative World Datum. --Auth.

1-430. Kaula, W. M. RECONCILIATION OF STOKES FUNCTION AND ASTRO-GEODETIC GEOID DETERMINATIONS: Jour. Geophys. Research, v. 64, no. 1, p. 61-71, table, Jan. 1959, 26 refs.

The combined application of astronomic, geodetic, and gravimetric data to computations of the geoid is discussed. The general principle observed is that any adjustment should weight all observations inversely as their variances. Two conditions are imposed: (1) Geoid heights and deflections computed by Stokes' theorem from gravity data must equal those derived by astrogeodetic means. (2) The 5 harmonics, $P_1$, $P_1^1 \sin \lambda$, $P_1^1 \cos \lambda$, $P_2^1 \sin \lambda$, and $P_2^1 \cos \lambda$ must be absent from the adjusted gravity field. The ideal case is discussed, including provision for separate determinations of parameters by independent astronomic methods. Practical modifications are then introduced in turn: treating gravity anomalies are representative of areas; holding geodetic or astronomic observations constant; using a reduced number of astronomic stations; and comparing interpolated points of the astro-geodetic and gravimetic geoids. The most significant discrepancy from the ideal case of most practical solutions made heretofore appears to be in the weighting of the gravimetric data. --Auth.

1-431. Talwani, Manik, J. Lamar Worzel, and Mark Landisman. RAPID GRAVITY COMPUTATIONS FOR TWO-DIMENSIONAL BODIES WITH APPLICATION TO THE MENDOCINO SUBMARINE FRACTURE ZONE: Jour. Geophys. Research, v. 64, no. 1, p. 49-59, 6 figs. incl. chart, 2 tables, Jan. 1959, 14 refs.; also pub. as: Lamont Geol. Observatory, Contr. no. 318, 1958.

Expressions are derived for the vertical and horizontal components of the gravitational attraction due to a 2-dimensional body of arbitrary shape by approximating it to an n-sided polygon. These expressions are put in forms suitable for solution by a high-speed digital computer. As an example of the application of this method, the crustal section across the Mendocino fracture zone [off Cape Mendocino, California] is deduced from the gravity anomalies. Assuming the crust to consist of a single homogeneous layer, overlain by water and sediment, it is found to be about 3 km. thicker to the N. of the fracture zone than to the S. of it. --Auth.

1-432. Hansen, Richard T. RECURRENT GEOMAGNETIC STORMS AND SOLAR PROMINENCES: Jour. Geophys. Research, v. 64, no. 1, p. 23-25, 3 figs., Jan. 1959, 15 refs.

A study is made of the run of areas of solar prominences around days of recurrent geomagnetic storms during the period 1917-1944. "Character figures for dark H-alpha flocculi," taken from IAU Quarterly Bulletins of Solar Activity, are used as the measure of prominence areas. The earlier suggestions that the solar M-regions may be identified as quiescent prominences have been confirmed. --Auth.

1-433. Randall, John A. THE USE OF THE DIP-NEEDLE IN LOCATING CONTACTS: Compass, v. 36, no. 2, p. 114-23, 4 figs., Jan. 1959, 2 refs.

This paper reports the results of dip-needle traverses across a serpentine dike, a soapstone intrusive, and the Martic overthrust in Pennsylvania, and the Stillwater complex and a metasedimentary section in Montana. Positive results were obtained in the location of contacts which agreed well with the results obtained by geologic methods. This work demonstrates the advantages of the dip-needle, which include speed, accuracy, and ease of use by persons with little training in geophysics. --Auth.

1-434. Kobets, N. V., and B. V. Komarov. NEKOTORYYE VOPROSY METODIKI POISKOV KORENNYKH MESTOROZHDENIY ALMAZOV NA OSNOVE AEROMETODOV [PROBLEMS OF PROSPECTING FOR ORIGINAL DIAMOND DEPOSITS BY AERIAL METHODS]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 2, p. 85-93, 4 illus., 3 refs.

The authors describe the methods applied for the organization of systematic prospecting in the region of the first diamond find in Yakutia [65°N. 130°E]. The Laboratory of Aerial Methods, Academy of Sciences, USSR, on the initiative of the Member-Correspondent N. G. Kell, sent an expedition which made a detailed survey of the region, combining aerial photo-survey with geophysical methods - magnetic and aerial-magnetic survey. The aim of this expedition was to find the kimberlite bodies, so called because the first diamond deposits were connected with ultrabasic rocks, which by their structural, petrographic, and mineralogic peculiarities were similar to the kimberlites of South Africa. The authors describe in detail the working out of the combined survey which resulted in finding 3 new kimberlite bodies. --LC.

1-435. Bhattacharyya, Bimal Krishna. ELECTROMAGNETIC FIELDS OF A TRANSIENT MAGNETIC DIPOLE ON THE EARTH'S SURFACE: Geophysics, v. 24, no. 1, p. 89-108, 9 figs. incl. diag., graphs, Feb. 1959, 5 refs.

Transient electric and magnetic fields close to the surface of the earth, as developed by a step-function current flowing in a circular loop of wire, have been determined. The effect of the insulating air region is fully taken into account. It is observed that the air region has an appreciable influence on the fields over the surface of the earth. The effect of displacement current within the earth has also been considered. Expressions of electric and magnetic fields have been utilized to determine (a) the mutual impedance function between the primary loop and a small length of wire and (b) the voltage induced in a secondary loop. Both these functions are found to have appreciable magnitudes only during the time interval between the arrival of the wave travelling through air and that of the wave via the conducting medium. From a study of this duration and the initial amplitude of either of the 2 functions, it is possible to obtain values of conductivity and permittivity of the earth. Curves have been plotted to depict the nature of variation of these functions with time for different values of the electric constants of the earth. --Auth.

1-436. Slichter, Louis B., and Leon Knopoff. FIELD OF AN ALTERNATING MAGNETIC DIPOLE ON THE SURFACE OF A LAYERED EARTH: Geophysics, v. 24, no. 1, p. 77-88, 16 graphs, 3 tables, Feb. 1959, 7 refs.; also pub. as: California, Univ. (Los Angeles), Inst. Geophysics, Pub. no. 114.

The magnetic field near a vertical alternating magnetic dipole on the surface of a layered earth is computed for points on the surface. In the layer, the dimensionless conductivity parameter is assumed to take the values 0, 1/4, 1, and 4; in the homogeneous substratum, this parameter is assigned the values 0, 1/4, 1, 4, and infinity. The induced field is computed at distances from the source 1/2, 1, 2, 4, 8, and 16 times the layer thickness. --Auth.

1-437. Unz, M. INTERPRETATION METHODS FOR GEOPHYSICAL EXPLORATION OF RESERVOIRS: Geophysics, v. 24, no. 1, p. 109-41, 10 figs. incl. diags., cross-secs., graphs, table, Feb. 1959, 11 refs.

Geophysical exploration methods can be valuable for the investigation of filled storage reservoirs. Impressed current circuits or natural ground potentials are analyzed for this purpose. General structural data are obtained from horizontal resistivity profiles. Ground bed details and seepage zones can be located by means of underwater equipotential surveys. Salinity and temperature measurements serve for the hydrological investigation of submerged springs and streams in natural lakes. The proposed interpretation methods can be readily adapted to specific local conditions. --Auth.

1-438. DuShane, Graham. UNIDENTIFIED SEISMIC EVENTS: Science, v. 129, no. 3344, p. 241, Jan. 30, 1959, ref.

An ordinary earthquake sends out compression waves in some directions and waves of rarefaction in others. An artificial earthquake sends out, as the first motion, only compression waves. It is this characteristic difference which permits the identification of an artificial shock. However, at more distant stations, it is possible that the first identifying compression wave will be so swamped by background tremors that seismic stations need to be more closely spaced and better instruments need to be developed in order to differentiate more accurately between natural and artificial shocks. --G. E. Denegar.

1-439. Dorman, James. NUMERICAL SOLUTIONS FOR LOVE WAVE DISPERSION ON A HALF-SPACE WITH DOUBLE SURFACE LAYER: Geophysics, v. 24, no. 1, p. 12-29, 13 graphs, 8 tables, Feb. 1959, 10 refs.; also pub. as: Lamont Geol. Observatory, Contr. no. 322.

The IBM 650 computer of the Watson Scientific Computing Laboratory, Columbia University, was programmed to obtain numerical solutions for the period equation for Love waves on a half-space with a double surface layer. Solutions including higher modes for 7 models of the continental crust-mantle system are presented. This group of related cases shows that certain properties of the solutions are diagnostic of crustal structure. These relationships are illustrated graphically. --Auth.

1-440. Rosenbaum, J. H. A NOTE ON THE PROPAGATION OF A SOUND PULSE IN A TWO-LAYER LIQUID MEDIUM: Jour. Geophys. Research, v. 64, no. 1, p. 95-102, fig., Jan. 1959, 4 refs.; also pub. as: Shell Devel. Co., Explor. & Production Research Div., Pub. no. 169.

The contribution from the branch line integral in Pekeris' formulation of the propagation of explosive sound in a 2-layer liquid medium is investigated. It is shown that there is no net contribution to the solution in terms of pressure amplitude measured in the upper layer, which decays less rapidly than $r^{-2}$. The horizontal range, designated by r, is large compared with the depth of the layer. This result is applicable to early arrival pressure signals and is in agreement with recently published model experiments. --Auth.

1-441. Evans, J. F. SEISMIC MODEL EXPERIMENTS WITH SHEAR WAVES: Geophysics, v. 24, no. 1, p. 40-48, 7 figs. incl. diags., graphs, Feb. 1959, 7 refs.

The experimental study of shear waves in the earth has been limited by the difficulty of producing them in sufficient strength. However, sensitive piezoelectric shear plates can now be made which enable experimentation with shear waves using small-scale seismic models. Seismic model experiments serve to demonstrate the simplicity of SH-shear wave reflections in a single homogeneous layer, the production of SH waves by an impulsive horizontal thrust, and the development of relatively high amplitude Love waves in a low-velocity surface layer. The results of these model experiments with shear waves are in general agreement with and confirm theory. They also agree with the results of field experiments in the scattered cases for which comparison is available. --Auth.

1-442. Knopoff, Leon. SCATTERING OF COMPRESSION WAVES BY SPHERICAL OBSTACLES: Geophysics, v. 24, no. 1, p. 30-39, 4 figs., Feb. 1959, 11 refs.; also pub. as: California, Univ. (Los Angeles), Inst. Geophysics, Pub. no. 119.

The scattering of plane P waves by a spherical obstacle is formulated. A calculation is given for the special case of scattering by a perfectly rigid sphere in which the medium outside has a Poisson's ratio of 1/4. The range of sizes of obstacles used in the calculation includes radii very small compared with wave length and radii comparable to the wave length. For incident P waves, scattered P and S are computed with shifts in time phase occurring in both with respect to the incident beam. For small obstacles, the scattered S wave is generally broadside to the scattered P-wave beam. --Auth.

1-443. Seriff, A. J. THE RESPONSE OF SEISMOMETERS IN SERIES AND PARALLEL CONNECTIONS: Geophysics, v. 24, no. 1, p. 49-63, 3 figs., table, Feb. 1959; also pub. as: Shell Devel. Co., Explor. & Production Research Div., Pub. no. 171, 1958.

Two similar seismometers connected in series with a load exhibit 2 independent or "normal" modes of motion. In the first mode, the 2 coils move so that the voltages generated are almost equal and in phase, producing a large current in the circuit and considerable damping of the motion. This is the mode normally considered in designing the external damping circuit for series seismometers. In the second mode, the coils move nearly 180° out of phase, produce a relatively small current in the circuit, and, consequently, experience very little damping in addition to their open-circuit damping. Strong initial excitation of this mode can produce a sustained oscillation damaging to later parts of the seismic record.

The usual mathematical description of this system, i.e., 2 harmonic oscillators coupled through their damping terms, readily yields approximate expressions for the size and damping of the load current in the case of nearly identical seismometers with little internal damping. For example, 2 such seismometers connected to a load producing large damping for the first mode will exhibit a damping of only $(\omega_1 - \omega_2)^2/4\omega f$ in the second mode. Here $\omega_1$ and $\omega_2$ are the angular frequencies of the 2 separate seismometers, $\omega$ is the average angular frequency, and $f$ is the fraction of critical damping for the first mode.

Two seismometers connected in parallel can have considerable electromagnetic damping in both modes of oscillation.

For n seismometers in series, there are n - 1 modes which may be poorly damped. The frequencies of these modes are distributed so that one lies between each adjacent pair of the original uncoupled frequencies. The damping in each mode is of the order of $n(\omega_k - \omega_{k+1})^2/8\omega f$.

The steady-state characteristics can be readily examined using the seismometer equivalent circuits. The result is strongly dependent on the mode of excitation. For example, if 2 similar seismometers are connected in series but only one is excited, the frequency characteristic shows both a maximum near the rms. of the 2 seismometer frequencies and a minimum at the frequency of the seismometer not excited. --Auth.

1-444. Gaither, V. U. INDEX OF WELLS SHOT FOR VELOCITY (SEVENTH SUPPLEMENT): Geophysics, v. 23, no. 5, p. 982-1023, Dec. 1958.

This is the Seventh Supplement to the original Index published in the 1944 issue of Geophysics. Information is listed on 2,382 well velocity surveys not reported in any of the previous Indexes. Corrections and/or additional information on 85 previously listed surveys are also tabulated. --Auth.

1-445. Milne, W. G., and W. R. H. White. SEISMIC INVESTIGATION OF MINE "BUMPS" IN THE CROWSNEST PASS COAL FIELD: Canadian Mining & Metall. Bull.: v. 51, no. 559, p. 678-85, 9 figs. incl. 3 illus., 8 tables, Nov. 1958, ref.

In Sept. 1953, seismographs were installed in the Crowsnest Pass area of Alberta and British Columbia to study the "bumps" which were occurring in the coal mines at Fernie and Coleman, and to investigate the possibility that they might be related to minor earthquakes in the area. During the initial phase of the work, 3 seismographs were operated at widely separated stations, 2 in the region of coal mines at Coal Creek and Coleman and one at Turner Valley, distant from any mining operations. Some earthquakes were recorded at all 3 stations, and, in addition, many small disturbances were recorded by the seismographs located near the mines, especially by the instrument at Coal Creek. A close network of radio-linked seismographs was then installed near Fernie, the records of which definitely established that the small disturbances were occurring in the mine workings, both active and inactive. No relationship was established between bumps and local earthquakes in the area. --Auth.

**1-446.** Martin, Jack, and Thomas O. Hall. **AMMONIUM NITRATE: ECONOMY BLASTING AGENT FOR OIL EXPLORATION: Geophysics, v. 24, no. 1, p. 155-63, 5 figs., Feb. 1959, ref.**

Major savings for operators of seismic parties have been achieved by the use of prilled ammonium nitrate as a substitute for gelatin dynamite in areas where shot holes are dry. Pound for pound, the prills appear to have the same energy yield as 60% gelatin dynamite, and some improvement of records has been noted where prills are used. Safety problems are fewer with ammonium nitrate than with dynamite, and the development of efficient field handling techniques prevents the loss of production. --Auth.

**1-447.** Ruff, Arthur W. **SEISMIC-WAVE MEASUREMENTS IN UNDERGROUND BLASTING: Mines Magazine, v. 48, no. 12, p. 8-15, port., 21 figs. incl. 2 illus., Dec. 1958, 3 refs.**

Reflected-wave theory applied to blasting has shown that the reflected tension wave from an exploded charge produces rock failure. Therefore, the character of the seismic wave at the point of failure and the rock strength should determine the type of primary fracturing, and measurement of the character of the wave from an exploded charge should indicate the relative efficiency of the wave source and the transmitting medium. Shielding and bonding of strain gages, the strain-gage circuit, cap-firing circuit, and powder comparisons in testing are briefly described. The principle of superposition of seismic waves and the effect of stemming on seismic waves are discussed. Results are analyzed. --G. E. Denegar.

**1-448.** Kokesh, F. P., and R. B. Blizard. **GEOMETRICAL FACTORS IN SONIC LOGGING: Geophysics, v. 24, no. 1, p. 64-76, 10 figs. incl. diags., graphs, Feb. 1959, ref.**

The purpose of the sonic log is to measure formation velocity, but various geometrical factors can cause apparent velocity readings substantially different from the true velocity at the depth of measurement. An understanding of these factors enables one to derive greater value from the log. Bed thickness, hole size, caves, alteration of the formation adjacent to the bore, spacing of the transducer, and whether the tool is centered in the bore are among the factors influencing the log. Centering the tool can increase the signal strength, but in large holes and slow formations the first arrival may come through the mud. The transmitter-receiver spacing which is needed to avoid this is given for various hole sizes and formation velocities. The effect of caves is shown with theoretical and actual curves. There is some evidence that action of the mud or stress concentration around the bore can alter the velocity of the formation; the effect on the indicated velocity is shown as a function of transducer spacing and of degree and depth of velocity alteration. --Auth.

**1-449.** Benseman, R. F. **THE CALORIMETRY OF STEAMING GROUND IN THERMAL AREA: Jour. Geophys. Research, v. 64, no. 1, p. 123-26, illus., 2 diags., Jan. 1959, 3 refs.**

A portable calorimeter that measures heat output from the steaming ground found in areas of natural thermal activity is described. With a minimum of disturbance to the site, heat flow is measured in a range from 10 to 70 X $10^{-3}$ cal./cm.$^2$ sec. with an accuracy better than 10%. Below this range, the accuracy decreases. The relationship of heat output to the soil temperatures measured at a depth of 35 cm. is shown for measurements of 27 different sites. --Auth.

## 7. GEOCHEMISTRY

See also: Stratigraphy 1-388; Mineralogy 1-467; Sedimentary Petrology 1-481; Mineral Deposits 1-500; Fuels 1-527.

**1-450.** Czamanske, Gerald K. **SULFIDE SOLUBILITY IN AQUEOUS SOLUTIONS: Econ. Geology, v. 54, no. 1, p. 57-63, 2 tables, Jan.-Feb. 1959, 17 refs.**

The values for sulfide solubilities in aqueous solutions which are currently available in the geological literature need extensive revision as the result of redeterminations of basic thermodynamic data. New solubility data for 9 of the common sulfides are presented. Calculations have been made for temperatures of 25°, 100°, 200°, 400°, and 600° C., at pH values of 3, 7, and 11. The current opinion that the simple solubilities of the sulfides cannot alone account for their transport in ore fluids is not challenged. --Auth.

**1-451.** Holser, William T., and George C. Kennedy. **PROPERTIES OF WATER. PART V. PRESSURE-VOLUME-TEMPERATURE RELATIONS OF WATER IN THE RANGE 400-1000 C and 100-1400 BARS: Am. Jour. Sci., v. 257, no. 1, p. 71-77, 2 tables, Jan. 1959, 7 refs.; also pub. as: California, Univ. (Los Angeles), Institute of Geophysics, Pub. no. 115.**

New measurements of specific volume of water along 11 isotherms in the range 400-900 C. were correlated and extrapolated to form a smooth table of specific volumes extending to 1000 C. and 1400 bars. --Auth.

**1-452.** Robbins, C. R., and E. M. Levin. **THE SYSTEM MAGNESIUM OXIDE-GERMANIUM DIOXIDE: Am. Jour. Sci., v. 257, no. 1, p. 63-70, fig., 2 tables, Jan. 1959, 14 refs.**

The phase equilibrium diagram for the system MgO-GeO$_2$ has been determined by the quenching method. Three compounds are found in the system: MgO.GeO$_2$, melting congruently at 1700 ± 20°C.; 2MgO.GeO$_2$; and 4MgO.GeO$_2$, which dissociates at 1495 ± 10°C. to 2MgO.GeO$_2$ and MgO. A region of 2-liquid immiscibility extends from 8 to 34 mole % of MgO. Optical and x-ray data are given for the compounds, including a new monoclinic polymorph of MgO.GeO$_2$ which is analogous to clinoenstatite (MgO.SiO$_2$). This polymorph, apparently stable above 1555°C., inverts to the orthorhombic form (analogous to enstatite) with heating below that temperature. A protoenstatite phase was not observed, although a detailed study was not attempted. Important differences between the $MgO-GeO_2$ and $MgO-SiO_2$ systems are that no 4:1 silicate compound is known and that $MgO.GeO_2$ melts congruently at a much higher temperature than the incongruently melting metasilicate. --Auth.

**1-453. Ringwood, A. E. THE CONSTITUTION OF THE MANTLE - III. CONSEQUENCES OF THE OLIVINE-SPINEL TRANSITION: Geochim. et. Cosmochim. Acta, v. 15, no. 3, p. 195-212, 2 figs., table, Dec. 1958, 32 refs.**

Evidence on the chemical composition of the mantle is reviewed. Based upon studies of the inclusions in kimberlite pipes, intrusion of peridotites in orogenic regions, and the compositions of stony meteorites and kimberlite, it is suggested that the average composition of the mantle may approximate that of a garnet peridotite. However, the upper mantle immediately below the M -discontinuity may be poorer in sialic material and close to normal dunite-peridotite in composition.

When garnet peridotite is subjected to high temperatures and pressures, a series of transitions dominated by the olivine-spinel transition occurs. Besides the olivine-spinel transition, pyroxene may invert to spinel plus coesite, while garnet and coesite may dissolve in the spinel at higher temperatures to form a highly disordered defect solid solution. The data in Pts. I and II show that these changes should occur under the P-T conditions present in the upper 1000 km. of the mantle and take place over an appreciable depth range. The position and extent of this transition range depends upon the assumed temperature distribution in the upper mantle. By choosing a suitable temperature distribution, the transition region can be made coincident with region C (Bullen) in which phase changes and inhomogeneity have been inferred on other grounds.

It is found that the proposed transition phenomena are capable of explaining the known data on seismic velocity distribution, elasticity and density in the mantle. The temperature distribution required to make the phase transition region coincident with region C is supported by recent studies of the temperature dependence of electrical conductivity in the mantle. Both convection and conduction mechanisms of heat transfer may give rise to this temperature distribution.

A specific model for the mantle is proposed. --Auth.

**1-454. Anderson, A. J., and E. J. Underwood. TRACE-ELEMENT DESERTS: Sci. American, v. 200, no. 1, p. 97-106, 5 illus., map, Jan. 1959.**

Trace elements now recognized as essential to plant life are Fe, Mn, Cu, Zn, Mb, B, and Cl. Cu, Zn, and Mb are the elements that cropland and pasture lack most often. Until recently, South Australia's Ninety Mile Desert was wasteland. Infertility of the soil was found to arise from the lack of trace quantities of Zn and Cu which was then remedied. This type of soil reclamation is being initiated in other parts of Australia where deficiencies of essential trace elements are being reduced. While Cu and Zn deficiencies occur in southern and western Australia, the east suffers mainly from lack of Mb.

Trace-element deficiencies affect animal productivity. Cu deficiencies seem to affect the breeding performance of ewes, as well as the quality of wool. Zn, Co, Fe, Mb, Mn, and other trace elements are essential to livestock health. Although trace-element deficiencies have little direct effect on man, their indirect effects are profoundly important. --G. E. Denegar.

**1-455. Karkhanavala, M. D. ON RADIOACTIVE URANIFEROUS IRON OXIDES: Geochim. et Cosmochim. Acta, v. 15, no. 3, p. 229-36, 2 figs., 3 tables, Dec. 1958, 20 refs.**

A study has been made of U-bearing iron oxides from the shear-zone of Bihar, with particular reference to the nature of the association of U with magnetite and hematite. In veins where none or very little hematitization has taken place, the primary magnetite and uraninite coexist. Where hematitization has taken place the U is very intimately associated with the hematite, probably as a very limited solid solution. A sample of hematite containing U equivalent of 0·15% $U_3O_8$ was found to be metamict, the reconstitution of which was established by x-ray and differential thermal analysis methods.

It is believed that a primary oxidizing solution containing uranyl ions caused the oxidation of the ferrous hydrosol to magnetite and the simultaneous precipitation of uraninite. A later-stage oxidizing solution or normal agents of weathering converted the magnetite to hematite and the uraninite to probably $U_3O_8$ or $UO_3$, a small amount of which was then somehow taken up in the hematite lattice, and the rest being converted to secondary U minerals, the presence of which is known. --Auth.

**1-456. McLaughlin, R. J. W. GEOCHEMICAL PARTITION IN TWO ILLITIC CLAYS: Geochim. et Cosmochim. Acta, v. 15, no. 3, p. 165-69, table, Dec. 1958, 14 refs.**

Chemical data for both major and minor elements are given for sand, silt, and clay fractions of 2 illitic clays. The gradations are traced and geochemical enrichment discussed. --Auth.

**1-457. El Wardani, S. A. MARINE GEOCHEMISTRY OF GERMANIUM AND THE ORIGIN OF PACIFIC PELAGIC CLAY MINERALS: Geochim. et Cosmochim. Acta, v. 15, no. 3, p. 237-54, fig., 12 tables, Dec. 1958, 25 refs.**

The Ge content of sea water was found to be 0·05 μg/l. The most abundant organisms of sea water do not take up detectable amounts of Ge. Globigerina ooze and siliceous sponges are devoid of Ge. Diatom frustules may contain some 0·4 ppm. Ge. The Pacific NE. equatorial eupelagic clays contain 2 ppm. Ge in contrast to shelf material and the S. equatorial eupelagic clays, which contain 1 ppm. Ge.

Shelf sediments and pelagic clays have an identical Ge content of 1 ppm. for their coarse fractions while the clay-mineral size fraction of the Pacific NE. equatorial eupelagic clays has a Ge content at least twice the value for the same fraction of the Pacific S. equatorial pelagic clays, shelf sediments, and standard marine clay minerals which have been reported to contain 1 ppm. Ge.

The aluminosilicates are primarily responsible for the Ge content of the clays, and partial removal of the element from sea water appears to take place during the hydrogenous growth of such minerals in sea water. The geochemical fractionation of the element between the shelf and deep-sea sediments and their abundant minerals suggests that shelf sediments and the Pacific S. equatorial pelagic clays are primarily lithogenous in origin. On the other hand, the Pacific NE. equatorial eupelagic clays have a coarse fraction which is primarily lithogenous in origin and a clay-mineral size fraction which is rich in hydrogenous clay minerals. --Auth.

**1-458. Friedman, Irving, and Robert L. Smith. THE DEUTERIUM CONTENT OF WATER IN SOME VOLCANIC GLASSES: Geochim. et Cosmochim. Acta, v. 15, no. 3, p. 218-28, 6 figs. incl. illus., 3 tables, Dec. 1958, 3 refs.**

The deuterium-hydrogen composition (relative to Lake Michigan water = 0·0) of water extracted from coexisting perlite and obsidian from 11 different localities was determined. The water content of the obsidians is generally from 0·09 to 0·29% by weight, though 2 samples from near Olancha, California, contain about 0·92%. The relative deuterium concentration is from -4·6 to -12·3%. The coexisting perlite contains from 2·0 to 3·8% of water with a relative deuterium concentration of -3·1 to -16·6%. The deuterium concentration in the perlites is not related to that in the enclosed obsidian. The deuterium concentration in the perlite water is related to the deuterium concentration of the modern meteoric water, and the perlite water contains approximately 4% less deuterium than does the ground water of the area in which the perlites occur. The above relations hold true for perlites from northern New Mexico, E. slope of the Sierra Nevada, California Coast Range, Yellowstone Park, Wyoming, and New Zealand. As the water in the obsidian is unrelated to meteoric water, but the enclosing perlite water is related, we believe that this is evidence for the secondary hydration of obsidian to form high water content perlitic glass. --Auth.

**1-459. Holmes, Arthur. SPITSKOP CARBONATITE, EASTERN TRANSVAAL: Geol. Soc. America, Bull., v. 69, no. 12, p. 1525-26, Dec. 1958, 9 refs.**

$O^{18}/O^{16}$ and $C^{13}/C^{12}$ ratios indicate that the Spitskop crystalline limestone of eastern Transvaal is a carbonatite and that its source is not the thick dolomite series of the Transvaal system as stated by Stoll (1958). Sedimentary carbonate rocks, in accordance with their formation in an open system at low temperatures, are appreciably richer in the heavier isotopes than are the carbonatites, which have a high temperature source. --G. E. Denegar.

**1-460. Walker, E. C., F. Cuttitta, and F. E. Senftle. SOME NATURAL VARIATIONS IN THE RELATIVE ABUNDANCE OF COPPER ISOTOPES: Geochim. et Cosmochim. Acta, v. 15, no. 3, p. 183-94, 4 figs., 5 tables, Dec. 1958, 17 refs.**

The relative isotopic abundance of Cu has been measured in a number of minerals and a few plant materials. Suites of samples from Michigan and the Colorado Plateau have been examined in more detail to determine if local variations due to isotopic exchange or diffusion could be found. The relative isotopic abundance of Cu in specimens from several other localities was also determined. The variations noted were small but in some cases were felt to be significant because they were larger than the experimental error (0·1% in the ratio). A total spread of -1 to +8 ppm. compared to the standard was found in the specimens tested. --Auth.

**1-461. Boyle, R. W. SOME GEOCHEMICAL CONSIDERATIONS ON LEAD-ISOTOPE DATING OF LEAD DEPOSITS: Econ. Geology, v. 54, no. 1, p. 130-35, Jan.-Feb. 1959, 8 refs.**

The validity of age determinations based on the Pb-isotope ratios of galena or other Pb minerals in deposits is questioned. A few simple examples are given to show that fractionation of Pb isotopes in geochemical processes is probable. The geochemical processes through which Pb has passed must be considered in detail before an age can be assigned to a Pb deposit. --Auth.

## 8. MINERALOGY AND CRYSTALLOGRAPHY

See also: Stratigraphy 1-388; Paleontology 1-412; Geochemistry 1-456; Sedimentary Petrology 1-482, 1-484; Mineral Deposits 1-504.

**1-462. Milton, Charles, and Edward C. T. Chao. ESKOLAITE, $Cr_2O_3$, IN "MERUMITE" FROM BRITISH GUIANA: Am. Mineralogist, v. 43, no. 11/12, p. 1203, Nov.-Dec. 1958, ref.**

Eskolaite is a major constituent of black pebbles found in the Merume River bed. The pebbles were described by Bracewell (1946) as a new mineral, merumite. Actually merumite is an aggregate of eskolaite and possibly 2 new chromium oxide minerals with quartz, pyrophyllite, and perhaps other substances. Analyses of merumite show that $Cr_2O_3$ generally exceeds 75%, alumina and water 7% or 8% each, and silica, iron and titania from about 1% to 5%. Vanadium is less than 0.2%. X-ray diffraction patterns of British Guiana eskolaite and that of commercial reagent anhydrous chromic oxide $Cr_2O_3$ are identical. Little is known of the provenance of British Guiana merumite. None of the minerals associated with eskolaite in Finland were found in the samples of merumite. --A. C. Sangree.

**1-463. Smith, Robert L. SOME NEW OCCURRENCES OF SASSOLITE IN THE UNITED STATES: Am. Mineralogist, v. 43, no. 11/12, p. 1204-5, Nov.-Dec. 1958, 3 refs.**

Sassolite ($B_2O_3 . 3H_2O$), a rare boron mineral, occurs in crystalline incrustations in a siliceous sinter terrace at Steamboat Springs, Washoe County, Nevada; in the Sonoma County geyser area, California; and in the Norris Geyser Basin of Yellowstone National Park. --G. E. Denegar.

**1-464. Whittle, Alick W. G. THE NATURE OF DAVIDITE: Econ. Geology, v. 54, no. 1, p. 64-81, 14 figs. incl. map, photomicrographs, 2 tables, Jan.-Feb. 1959, 11 refs.**

The Precambrian rocks of Australia contain a wider variety of davidites than has been found elsewhere in the world.

Investigation of davidite occurrences as an economic U ore over a number of years has revealed its many peculiar physical and chemical characteristics.

It has been shown to be a primary mineral generally associated with sodium-rich acidic igneous rock as replacement lode deposits, as disseminated replacement deposits, as fissure fillings of pneumatolytic origin and as an accessory mineral in pegmatites.

Its association with titania, both as regular and recognizable inclusions of rutile and ilmenite, and as the less apparent sub-microscopic titaniferous "framework," raises the question as to whether the generally accepted description and composition of davidite is valid. --Auth.

**1-465. Mitchell, Richard S., and William F. Giannini. NATROJAROSITE FROM NEAR THE MONTANA-WYOMING LINE: Am. Mineralogist, v. 43, no. 11/12, p. 1205-10, map, table, Nov.-Dec. 1958, 8 refs.**

Natrojarosite, $NaFe_3(SO_4)_2(OH)_6$, associated with carbonized-wood fragments and gypsum, occurs as a very fine-grained bright-yellow powder in a fine-grained sandstone in Carbon County, Montana. Observed x-ray powder values indicate slightly larger structure cell dimensions than reported for this mineral. This may be caused in part by a slight isomorphous replacement of sodium by potassium. Discovery of a second natrojarosite locality in Big Horn County, Wyoming, suggests that the mineral may be of widespread occurrence in the Morrison formation within and around the Big Horn Basin. --G. E. Denegar.

**1-466. Breck, D. W., and J. V. Smith. MOLECULAR SIEVES: Sci. American, v. 200, no. 1, p. 85-94, illus., graphs., Jan. 1959.**

The unique porous molecular structure of zeolites explains their ability to give off water vapor upon heating without disintegration and to re-adsorb water upon cooling. Zeolites, complex silicates containing Al and one or more other metallic elements (usually Na, K, or Ca), can exchange electrically charged atoms (ions) with other substances. X-ray-diffraction patterns show that the crystal contains a precisely-arrayed network of minute cavities linked by apertures. The water molecules and exchangeable ions lie in these cavities, not in the crystal framework, and can pass through the apertures.

Synthetic zeolites were produced by the Linde Company to experiment with separation of atmospheric gases. Regulation of temperature was found to give precise control over the sieving properties of zeolites. Zeolite molecular sieves can separate molecules of different sizes and can also segregate molecules of the same size but different electrical properties. The crystals will adsorb water molecules in preference to any other substance. Zeolites can reduce the proportion of water in a gas or liquid to as low as 4 ppm. This provides the basis for an efficient drying technique applied commercially by chemical processors to handle large quantities of natural gas at low temperatures. Zeolites also show a strong affinity for unsaturated hydrocarbons. New industrial sieving techniques are being developed by choosing appropriate species of zeolites, matching their ionic content to the needs of a particular separation problem and regulating temperatures. --A. C. Sangree.

**1-467. Isaacs, Thelma, and Rustum Roy. THE $\alpha$ - $\beta$ INVERSIONS IN EUCRYPTITE AND SPODUMENE: Geochim. et Cosmochim. Acta, v. 15, no. 3, p. 213-17, fig., 2 tables, Dec. 1958, 7 refs.**

Reversible hydrothermal experiments have allowed the unequivocal determination of the p-t dependence of the $LiAlSiO_{4(\mathrm{willemite})} \rightleftharpoons Li\overline{Al}\,\overline{S}iO_{4(\mathrm{high\text{-}quartz})}$ reaction. This constitutes one of the few reconstructive phase changes so studied. The revised $\alpha$ - $\beta$ inversion temperature at atmospheric pressure is set at 848 ± 5°C. and the enthalpy of inversion is calculated as 3750 cal./mole $LiAlSiO_4$.

It was found impossible to study the $\alpha$ - $\beta$ spodumene inversion, since in no case could $\alpha$-spodumene be synthesized from its own composition at pressures up to 400 atm. The assemblage $\alpha$-eucryptite + petalite appeared consistently instead. --Auth.

**1-468. Serdyuchenko, D. P. O SOSTAVE I GENEZISE DYUMORTYERITOV [ON THE COMPOSITION AND GENESIS OF DUMORTIERITES]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 2, p. 109-14, table, 22 refs.**

This article is partly a recapitulation of 2 articles published during the last 4 years in Prague by F. Fiala and I. Losert, describing deposits of dumortierites in the region of Kutna Hora, Czechoslovakia [49°57'N. 15°16'E.]. It also gives data on other deposits of this mineral throughout the world. The author disagrees with the theories of the genesis of dumortierites, and on the role of boron, the most characteristic component of the mineral. The author presents his own point of view on the genesis of dumortierites and describes the chemical composition of dumortierites from various deposits in Europe and America. --LC.

**1-469. Walker, Raymond F., Samuel Zerfoss, Sylvanus F. Holley, and Lucy J. Gross. TEMPERATURE OF THE INVERSION IN CRISTOBALITE: U. S. Natl. Bur. Standards, Jour. Research, v. 61, no. 4, p. 251-61, 4 figs., 7 tables, Oct. 1958, 22 refs.**

The inversion temperatures of cristobalite prepared from pure precipitated silica gel was compared with that of less pure cristobalite, including material derived from quartz. All material showed a variability in their inversion temperature which was dependent on their thermal history. However, evidence suggested that a sufficiently extended heat treatment at high temperatures would in each case produce a uniform product with invariant inversion temperatures attributable to the low-high and high-low inversions. It is proposed that the variability of the inversion temperature can be rationalized in terms of 3 rate processes dependent on the temperature of heat-treament, viz., nucleation, ordering, and crystal growth. The effect of all other factors known to influence the inversion temperature is either to accelerate or retard the rate of one or more of these processes. --Auth.

# 9. IGNEOUS AND METAMORPHIC PETROLOGY

See also: Structural Geology 1-371; Geochemistry 1-453, 1-458, 1-459.

1-470. Kudryashova, V. I. K VOPROSU OB OBRAZOVANII SHAROVYKH LAV SREDNEGO TECHENIYA R. NIZHNEY TUNGUSKI [ON PILLOW LAVA FORMATIONS IN THE CENTRAL PART OF THE LOWER TUNGUSKA RIVER]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 2, p. 94-99, 3 illus., fig., 18 refs.

The author concludes that the pillow texture of this lava was formed as a result of the cooling action of the water. The beds of the pillow lava were found mostly in the lower horizon of the lava series and usually formed lens-shaped flattened rocks 2 to 20 m. thick and 1.5 to 20 km. long. These pillows were composed of aphanitic vitro-basalts or of fine-grained diabases. The structure and petrographic composition of the pillow lava does not indicate the genesis of these rocks. The answer is given by analysis of the conditions of bedding and of the character of the underlying rocks. Usually, in the higher stratigraphic horizons of the lava series, the pillow lava beds lie on a uniform tuffaceous sandstone or tuffite, from 10 cm. to 1.5 m. thick. As many floral and faunal fossils, connected usually with fresh water, were found in these rocks, there is no doubt that the pillow lava was formed under aquatic conditions, and was not, as many geologists assumed, a product of a direct volcanic action. --LC.

1-471. Marmo, Vladi. ON THE $TiO_2$-CONTENT OF MAGNETITES AS A PETROGENETIC HINT: Am. Jour. Sci., v. 257, no. 2, p. 144-49, table, Feb. 1959, 8 refs.

Examination of the $TiO_2$-content of magnetites extracted from different rock types of the same schist belt shows that there may be, within the same orogeny, a close relationship between this $TiO_2$-content and the original material of the host rock. --Auth.

1-472. Whitten, E. H. Timothy. TUFFISITES AND MAGNETITE TUFFISITES FROM TORY ISLAND, IRELAND, AND RELATED PRODUCTS OF GAS ACTION: Am. Jour. Sci., v. 257, no. 2, p. 113-37, 7 figs. incl. geol. map, photomicrographs, 3 tables, Feb. 1959, 66 refs.

On Tory Island an unrecorded small swarm of saccharoidal leucocratic aplitic veins invades the "Older Granite" of Donegal. Microscopically the veins have granophyric margins; intimate shattering and penetration of the granitic country rock is accompanied by incorporation of xenoclasts of granite and neighboring metasediment. One vein is replete with magnetite grains (making it completely black in hand specimen), which crystallized between the 2 phases of intrusion of this composite aplite. Detailed structural and textural features suggest these veins are tuffisites resulting from gaseous fluidization (gas streaming). The magnetite appears to derive from decayed granitic mafics. The magnetite has cell dimension of pure $Fe_3O_4$ (Curie temperature $585 \pm 5^{\circ}C.$) and a very low Ti-content; this implies low-temperature crystallization according to Buddington, Fahey, and Vlisidis (1955), but the universal validity of their hypothesis is questioned. Evidence for very high-temperature crystallization of these tuffisites is advanced (c.f. Slieve Gullion tuffisites described by D. L. Reynolds). Xenolithic and xenocrystic rocks in numerous environments, and sedimentary dikes associated with igneous dikes, are discussed in relation to positive evidence of violent gas-phase activity during intrusion processes. --Auth.

1-473. Jaeger, J. C. TEMPERATURES OUTSIDE A COOLING INTRUSIVE SHEET: Am. Jour. Sci., v. 257, no. 1, p. 44-54, 2 figs., 2 tables, Jan. 1959, 12 refs.

Contact temperatures and temperatures in the country rock outside a cooling intrusive sheet are discussed, taking into account the effect of heat of solidification. It is shown that, for calculation of temperatures outside an intrusion, it is adequate to assume that the magma has a definite melting point instead of a melting range. On this assumption, contact temperatures, and temperatures in the country rock, are discussed with particular reference to dissimilar rocks. It is shown that the maximum temperatures attained in the country rock vary slowly with distance from the contact: the thin baked contact zones sometimes observed may be explained by pre-heating of the country rock for a short time before solidification commences. The theory is extended to cover the case of intrusion into wet sediments in which heat is absorbed by vaporization of pore-water, and calculated values of the contact temperature for a range of conditions are given. It is found in typical cases that a sheet is surrounded by a region of the order of half its thickness in which the country rock is heated in the presence of water vapor and vapor from the solidifying intrusion; beyond this to a distance of the order of the thickness of the sheet the country rock is heated in contact with vaporized pore-water; and beyond this again, it is in contact with heated pore-water only. The effect of movement of pore-water is also discussed approximately. The same theory applies to metamorphic reactions in the country rock, and the coking of coal is briefly discussed as an example. --Auth.

1-474. Bloxam, T. W. GLAUCOPHANE-SCHISTS AND ASSOCIATED ROCKS NEAR VALLEY FORD, CALIFORNIA: Am. Jour. Sci., v. 257, no. 2, p. 95-112, 2 figs. incl. geol. map, 2 pls. incl. photomicrographs, 5 tables, Feb. 1959, 19 refs.

Large residual masses of Franciscan glaucophane-schist, eclogite, and associated metamorphic rocks rest upon a basement of Franciscan graywackes and metagraywackes. The residual metamorphic blocks are probably relict masses from a former cover. Various stages in the transformation of graywackes and cherts into glaucophane-rocks have been observed in both basement rocks and residual masses. Progressive glaucophanization of residual blocks of eclogite also occurs, the final mineralogical and chemical composition approaching that of glaucophane-rocks derived from graywackes. Chemical changes accompanying the metamorphism of the graywackes involve an addition of Fe, Mg, and Ca, together with a decrease in Si and Na. These changes contrast with those which have produced glaucophane-rocks from the eclogites. The mineralogical character of the glaucophane-schists suggests affinities with the greenschist or epidote-amphibolite facies, but the instability of albite and the presence of hydrous minerals with high density indicates certain conditions peculiar to the glaucophane-schist facies; possibly high water-vapor pressure. --Auth.

1-475. Heron, S. Duncan, Jr., and James W. Clarke. THE HARBISON META-GRANODIORITE: South Carolina, State Devel. Board, Div. Geology, Bull., v. 2, no. 10, p. 69-75, 4 figs. incl. maps, Oct. 1958, ref.

Surrounded by felsic varieties of the Carolina slate, the Harbison meta-granodiorite composes a small pluton in NE. Irmo quadrangle. The structure is characterized by generally horizontal foliation. Several small rounded masses present in one road cut appear to be xenoliths. The rock is composed of euhedral plagioclase ($An_{30}$) phenocrysts embedded in an aggregate of anhedral grains of plagioclase, microcline, quartz, chlorite, and epidote. Hornblende, largely altered to chlorite, is present as phenocrysts. The porphyritic habit of the Harbison meta-granodiorite indicates an igneous origin as does the presence of xenoliths.

The following sequence of events is suggested for the area.

(1) Emplacement of hornblende granodiorite into a terrane of Carolina slate; attendant incorporation of xenoliths and development of a horizontal foliation.

(2) Emplacement of granitic dikes.

(3) Further development of foliation parallel to the primary foliation.

(4) Alteration of the mineral composition of the rock to a new mineral assemblage.

Stages (3) and (4) may have been contemporaneous. --A.C.Sangree.

1-476. Shenkman, Ya. D. O NEKOTORYKH PALEOZOYSKIKH INTRUZIYAKH VOSTOCHNOY TUVY [SEVERAL PALEOZOIC INTRUSIONS OF EASTERN TUVA]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 144-45, 1958.

Among the intrusions of eastern Tuva, the lower Paleozoic pre-Ordovician, pre-Silurian and Lower Devonian intrusions predominate. The author gives a brief description of the distribution, the petrographical structure, and the mineral composition of intrusive rock formations in this region. --LC.

# 10. SEDIMENTARY PETROLOGY

See also: Geomorphology 1-359; Geochemistry 1-457; Fuels 1-535.

1-477. Vatan, A. "DOLOSTONE": Jour. Sed. Petrology, v. 28, no. 4, p. 514, Dec. 1958, 2 refs.

Sedimentary-rock nomenclature is becoming crowded with newly-coined terms which are inappropriate, ambiguous, and badly constructed. "Dolostone" is typical. A discussion of this new term is given. --G. E. Denegar.

1-478. Inman, D. L., and T. K. Chamberlain. TRACING BEACH SAND MOVEMENT WITH IRRADIATED QUARTZ: Jour. Geophys. Research, v. 64, no. 1, p. 41-47, 5 figs., 2 tables, Jan. 1959, 8 refs.

The mechanics of transportation of sand under the influence of wave action was studied using artifically induced radioactivity. A sample of naturally occurring quartz sand is taken from the area of study, subjected to slow neutron irradiation, and then reintroduced into the area. The movement of the quartz is traced by sampling the sediment on the bottom and assaying for phosphorus-32, which is the principal radioisotope formed from the slow neutron irradiation of natural quartz sands.

In the field experiment, 860 g. of irradiated quartz sand was reintroduced as a point source on the sea floor off Scripps Beach. The experiment showed that the dispersal of sand by wave action was more rapid than expected, and that the movement of this small amount of sand could be followed for about 7 to 24 hours. The irradiated sand was released on the bottom by divers and samples were obtained on a grid at the time intervals of 1/4, 1, 3 1/2, 7 1/2, and 24 hours, and several days later. At the point of introduction the water was 10 ft. deep and the surface waves were about 1 1/4 ft. high. The waves caused the sand to spread in an elliptical pattern with an elongate onshore-offshore axis. The sampling indicated that the 860 g. of irradiated fine sand had been dispersed over an area of approximately three-quarters of a square mile in 24 hours. The sensitivity of detection for this experiment was approximately 1 grain of sand in 100,000. --Auth.

1-479. Prokopovich, N. SETTLING TUBE FOR MECHANICAL ANALYSIS BY DECANTATION: Jour. Sed. Petrology, v. 28, no. 4, p. 509, fig., Dec. 1959, ref.

A settling tube consisting of a pyrex cylinder, rubber cork, and funnel-ended glass tubing with outside clamp attached permits better separation than does siphoning. By eliminating suction currents, it avoids the admixture of coarser particles from the lower parts of the suspension. --G. E. Denegar.

1-480. Middleton, Gerald V. DIAGENESIS OF LOWERMOST DEVONIAN AT HAGERSVILLE, ONTARIO, CANADA: Geol. Assoc. Canada, Proc., v. 10, p. 95-107, 2 thin secs., Dec. 1958, 23 refs.

The basal Devonian beds (Onondaga) have been examined at exposures near Hagersville, Ontario. Field and petrographic studies indicate that silicification of the sandstone took place in 2 stages, the first being the formation of large chert nodules within the sand, and the second being the cementation of the sand by quartz overgrowth; both stages probably preceded dolomitization. In the Onondaga limestone, chert was formed soon after burial of the sediment, as colloidal silica filling cavities and replacing fossil and matrix carbonates. Silicification probably preceded dolomitization. The source of the silica for the formation of chert is believed to be organic, probably sponge spicules. The process of silicification is discussed in the light of recent advances in the colloid chemistry of silica. --Auth.

1-481. Forsman, J. P., and J. M. Hunt. INSOLUBLE ORGANIC MATTER (KEROGEN) IN SEDIMENTARY ROCKS: Geochim. et Cosmochim. Acta, v. 15, no. 3, p. 170-82, 5 figs., 6 tables, Dec. 1958, 19 refs.

Kerogen was isolated, by techniques developed in this study, from 21 rock samples representing a wide variety of geologic ages, rock types, and environments of deposition. These techniques make it possible to separate relatively mineral-free kerogen from rocks containing trace amounts of organic matter and to obtain reliable measurements of physical and chemical properties of kerogen. The 2 types of kerogens recognized in this study appear to be controlled by the nature of the original living matter deposited with the sediments, although metamorphic forces also appear to have affected the properties of kerogen. Hydrogenolysis of different kerogens results in soluble products varying appreciably in amount and type. --Auth.

**1-482. Goldman, Marcus I. PROBLEM OF THE ORIGIN OF FINE-GRAINED GYPSUM,"SUPER-INDIVIDUALS," AND SELENITE IN GYPSUM ROCK: Jour. Sed. Petrology, v. 28, no. 4, p. 510-13, 1958.**

The paper is the second in a discussion with Leo Ogniben. Three types of gypsum are considered: a type consisting of sharply defined small grains; a coarse selenitic type; and one consisting of poorly defined, complexly interrelated gypsum elements. The author interprets the first named as directly derived from hydration of anhydrite, and the last named as a stage in the development of selenite from the fine grained. Ogniben regards both as the product of crushing selenite. Bearing of remnants of anhydrite in gypsum, of sharp boundaries of fine-grained gypsum crystals, of phantoms of anhydrite in gypsum, and of the possible conditions of metamorphic changes in gypsum, on the origin of these materials, are discussed. --Auth.

**1-483. Folk, Robert L. PRACTICAL PETROGRAPHIC CLASSIFICATION OF LIMESTONES: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 1, p. 1-38, 5 pls. (photomicrographs), 7 figs., 2 tables, Jan. 1959, 17 refs.**

Limestones are divisible into 11 basic types, which are relatively easy to recognize both in the laboratory and in the field. These rocks are made up of 3 constituents: (1) allochems, evidently transported or otherwise differentiated carbonate bodies; (2) 1-4-micron microcrystalline calcite ooze matrix, and (3) coarser and clearer sparry calcite, which in most rocks forms as a simple pore-filling cement (like the calcite cement in a quartz sandstone), and only uncommonly forms by recrystallization. Only 4 types of allochems are volumetrically important in limestones: (a) intraclasts (reworked fragments of penecontemporaneous carbonate sediment), (b) oölites, (c) fossils, and (d) pellets (rounded aggregates of microcrystalline calcite averaging .04-.10 mm.). Allochems provide the structural framework of limestones, just as sand grains provide the structural framework of sandstones; microcrystalline calcite and sparry calcite are analogous with the clay matrix and chemical cement of sandstones.

A triangular diagram showing the relative proportions of allochems, calcite ooze matrix, and sparry calcite cement is used to define 3 major limestone families. Family I consists of abundant allochems cemented by sparry calcite; these are the cleanly washed limestones, analogous with well sorted, clay-free sandstones and similarly formed in loci of vigorous currents. Family II consists of variable amounts of allochems embedded in a microcrystalline ooze matrix; these are the poorly washed limestones that are analogous with clayey, poorly sorted sandstones, and form in loci of ineffective currents. Family III limestones consist almost entirely of calcite ooze, hence are analogous with terrigenous claystones.

Just as clayey versus non-clayey sandstones can be divided mineralogically into orthoquartzites, arkoses, and graywackes, similarly the first 2 limestone families are subdivided by considering the nature of the allochems. Family I includes respectively intrasparite, oösparite, biosparite, and pelsparite; family II includes intramicrite and oömicrite (both rare), biomicrite, and pelmicrite. Family III includes homogeneous ooze (micrite), and disturbed ooze with irregular openings filled with spar (dismicrite). Rocks made up largely of organisms in growth position are considered as a separate family IV (biolithite). Properties and mode of formation of each of these types are discussed briefly.

Content of admixed terrigenous material or dolomite is shown by additional symbols; pure dolomites are classified on allochem content and crystal size. Recrystallization in limestone is believed to be locally abundant but of over-all minor importance. Among several types of recrystallization, that in which a former microcrystalline ooze matrix recrystallizes to 5-15-micron "microspar" is considered most common.

The term "calclithite" is suggested for the terrigenous carbonate rocks, e.g., limestone conglomerates or sandstones made up of material eroded from outcrops of considerably older lithified-carbonate formations exposed in an uplifted source land. --Auth.

**1-484. Zen, E-An. CLAY MINERAL-CARBONATE RELATIONS IN SEDIMENTARY ROCKS: Am. Jour. Sci., v. 257, no. 1, p. 29-43, 6 figs., Jan. 1959, 38 refs.; also pub. as: Harvard Univ., Dept. Mineralogy & Petrography, Contr. no. 388; Woods Hole, Mass., Oceanographic Inst., Contr. no. 962.**

Mineralogical investigation of modern sediments off the coast of Peru and Chile reveals the presence of volcanic glass in many samples. The glass is commonly devitrified in sea water to fine aggregates of minerals, including calcite and kaolinite. The textural relations of these 2 phases suggest attainment of chemical equilibrium, and thus a thermodynamic analysis of their relationship is desirable.

A 7-component system, including the phases dolomite, calcite, chlorite, kaolinite, and quartz, is chosen for study. This system may be analyzed graphically if quartz is present in excess and $H_2O$ and $CO_2$ are taken as "mobile" components. The expected phase associations under a given set of conditions are studied in detail and agree with existing petrographic data; the agreement shows that the hypothesis of chemical equilibrium among these phases in sedimentary rocks should be seriously entertained. The idea of incompatible relationship between calcite and kaolinite is reviewed and the evidences for it are not compelling.

Possible complications due to other clay minerals and other components are briefly considered. The most likely sources of trouble are montmorillonite and the mixed-layer clays. Depending on its composition, the montmorillonite may change the geometry of the phase diagrams but will not affect the calcite-kaolinite binary join. Whether the mixed-layer clays will change the diagrams depends on whether such clays behave as mono- or polyphase systems, about which nothing is as yet known. --Auth.

**1-485.** Bourcart, Jacques. **LES SÉDIMENTS PRECONTINENTAUX PROFONDS DANS LE GOLFE DE GÊNES [DEEP PRECONTINENTAL SEDIMENTS IN THE GULF OF GENOA]: Deep-Sea Research, v. 5, no. 3, p. 216-22, fig., 1959, 10 refs.**

Although Mediterranean sediments below a depth of 200 to 300 m. are generally considered to be blue calcareous mud, dredging shows that under a thin layer of mud gravel occurs for 2000 m. A large rise, in steps, connects the foot of the continental slope, here rocky, with an abyssal plain between 2000 and 2700 m. It seems to extend all along the Gulf of Genoa. The sediments are essentially composed of coarse gravel of a continental facies with much carbonaceous material and some pteropods and foraminifera. --From auth. abs.(transl.)

## 11. GEOHYDROLOGY

See also: Areal and Regional Geology 1-343; Geophysics 1-437; Fuels 1-524.

**1-486.** Nash, J. E. **SYSTEMATIC DETERMINATION OF UNIT HYDROGRAPH PARAMETERS: Jour. Geophys. Research, v. 64, no. 1, p. 111-15, 4 figs., Jan. 1959, 9 refs.**

In unit hydrograph correlations the number of degrees of freedom which it is useful to maintain in the form of the instantaneous unit hydrograph is shown to be limited by the number of significant independent correlations with the catchment characteristics. The moments of the instantaneous unit hydrograph are suggested as a series of parameters of the response, for which correlations should be sought. A simple method of obtaining these moments is evolved, and a method of choosing, in any given case, between several 2-parameter forms is demonstrated. --Auth.

**1-487.** Rose, Walter. **CALCULATIONS BASED ON THE KOZENY-CARMAN THEORY: Jour. Geophys. Research, v. 64, no. 1, p. 103-10, 4 figs., 2 tables, Jan. 1959, 11 refs.**

Fluid flow in porous media, such as sands, sandstones, and carbonate rock, can be analyzed by experiment (Darcy's law) and by the Kozeny-Carman theory. The latter is based on the supposition that somehow the conductivity (permeability) of porous rocks is related to pore shapes and tortuosities, to the porosity, and to the boundary surface area against which the flowing viscous fluid is dragging. To test these ideas, a model of porous rock is selected which may be described as a random packing of spheres of various sizes. The porosity and surface-area terms are then calculated from geometric considerations. Then the character of the model is modified by assuming that a portion of the pore space is occupied by an immobile wetting phase located as pendular rings at each intersphere contact. The effective porosity and surface-area terms are calculated for this new condition, so that the effect of the pendular ring material on permeability can be computed, and so that a check of the Kozeny-Carman theory can be obtained.

The foregoing procedure is an indirect method which avoids the complication of explicitly evaluating pore shape and tortuosity parameters. It is shown that permeability appears to increase as pendular ring material is added to the packing, to an extent not inconsistent with expectations. --Auth.

**1-488.** Lewis, Tom. **STREAM POLLUTION (In: McGrain, Preston, and Thomas J. Crawford, eds. PROCEEDINGS OF THE TECHNICAL SESSION, KENTUCKY OIL AND GAS ASSOCIATION, TWENTY-SECOND ANNUAL MEETING, JUNE 5-6, 1958): Kentucky Geol. Survey, Spec. Pub. 1, Ser. 10, p. 25-27, 1958.**

There is more running water in Kentucky than in any other State in the Union. This is a great incentive to industries considering locations for new plants or relocation of existing facilities. In order to be attractive and usable water must be unpolluted. It is estimated that rain falling in the upper reaches of the Ohio River is used 9 times before being emptied into the Mississippi River, and each time it is used it must be purified. The Ohio River Sanitation Commission was created to deal with water pollution problems in the Ohio River area.

Production of crude oil creates 3 primary problems: waste oil dumped from tank batteries; waste oil bailed during drilling operations; and salt water. Waste oil can be disposed of by burning. Disposal of salt water, not now a problem, may, if not resolved soon, become a major pollution problem in the future. In the future all stream pollution cases will be referred to the Water Pollution Control Commission, which has the authority to hold hearings and trials, and to levy fines. --Auth.

**1-489.** Daniels, W. S., and M. D. Hale. **FLOODS OF OCTOBER 1954 IN THE CHICAGO AREA, ILLINOIS AND INDIANA: U. S. Geol. Survey, Water-Supply Paper 1370-B, p. 107-200, 11 figs., 1958.**

Detailed records of stage, discharge, and other pertinent data for the flood period are furnished. A section on flood frequency of the area and on flood-crest stages is included. The floods were the greatest in the history of the Chicago area. --U. S. Geol. Survey.

**1-490.** Schoppenhorst, C. E. **FLOODS OF JUNE-JULY 1957 IN INDIANA: U. S. Geol. Survey, Circ. 407, 32 p., 14 figs., 1958.**

This report describes the flooding which occurred on tributary streams on the central and lower White and Wabash River basins in Indiana. Records of daily discharge, discharge hydrographs, a summary table of flood stages and discharges, and other pertinent data for the flood period are given. A section on frequency of peak discharges is included. --U. S. Geol. Survey.

**1-491.** Harbeck, G. Earl, Jr., and Gordon E. Koberg. **A METHOD OF EVALUATING THE EFFECT OF A MONOMOLECULAR FILM IN SUPPRESSING RESERVOIR EVAPORATION: Jour. Geophys. Research, v. 64, no. 1, p. 89-93, table, Jan. 1958, 10 refs.**

Evaporation from a water surface may be reduced by the application of a monomolecular film. Because of possible seasonal variations in evaporation-pan coefficients, computed savings in evaporation may be unreliable if based upon evaporation-pan records. A more reliable measure of the evaporation reduction is obtained by the solution of equations based upon energy budget and heat and mass transfer theory. The rise in water-surface temperature caused by application of the film can be computed. --Auth.

1-492. Cardwell, G. T. GEOLOGY AND GROUND WATER IN THE SANTA ROSA AND PETALUMA VALLEY AREA, SONOMA COUNTY, CALIF.: U. S. Geol. Survey, Water-Supply Paper 1427, 273 p., 18 figs., 8 pls., 1958.

The Santa Rosa and Petaluma Valleys cover about 450 sq. mi. In 1949 the Merced and Glen Ellen formations and the alluvial deposits supplied nearly 15,000 acre-ft. of water to 10,000 wells with no regional overdraft. The estimated ground-water storage capacity of these deposits to a depth of 200 ft. is about 1,200,000 acre-ft. Quality of water generally is good, except locally in Petaluma Valley where sea water and connate water have invaded the aquifers. --U. S. Geol. Survey.

1-493. Bjorklund, L. J., and R. F. Brown. GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER SOUTH PLATTE RIVER VALLEY BETWEEN HARDIN, COLO., AND PAXTON, NEBR.: U. S. Geol. Survey, Water-Supply Paper 1378, 431 p., 17 figs., 4 pls., 1957, pub. 1958.

Irrigation is extensively developed in the valleys of the South Platte River and its tributaries. Because some waterlogging has occurred where diverted surface water is used for irrigation and, conversely, the water table has declined where ground water is pumped for irrigation, the need for a better balanced surface- and ground-water system is apparent. The ground water is obtained principally from unconsolidated alluvial deposits and generally is of satisfactory quality for irrigation and domestic uses. --U. S. Geol. Survey.

Section on chemical quality of the ground water, by H. A. Swenson.

1-494. Rasmussen, W. C., J. J. Groot, and N. H. Beamer. WELLS FOR THE OBSERVATION OF CHLORIDE AND WATER LEVELS IN AQUIFERS THAT CROSS THE CHESAPEAKE AND DELAWARE CANAL: Delaware Geol. Survey, Rept. Inv. no. 3, 22 p., 2 figs., 2 pls., Aug. 1958.

Three test wells were drilled near the banks of the Chesapeake and Delaware Canal, in aquifers formed by sand beds in 2 geologic units, the nonmarine Cretaceous sediments and the Magothy formation, which crop out along the sides and across the bottom of the canal. The canal carries tidal flow from the Delaware River to and from Chesapeake Bay. The purpose of the wells was to determine whether salt water from the canal has entered the water-bearing beds of these formations, and to determine the head of water in them. It was found that the sands contain fresh water, uncontaminated, and that apparently there was discharge of fresh water from the aquifers to the canal under low head, at least from the winter of late 1955 through early autumn 1957.

Measurements of chloride and specific conductance were made on water in the canal to see if there was a relation between the fluctuating quality of water there and the quality of water in the wells. The quality of water in the wells remained relatively constant and did not correlate with variations in the salt content of the water in the canal.

Enlargement of the canal, by widening it from the present width of 250 ft. to the proposed 450 ft., deepening it from channel depth of 27 ft. to the proposed 35 ft., straightening the bends, and constructing bypass and mooring areas, will increase the discharge of ground water and enhance the opportunity for salt-water encroachment, but in an amount and manner not yet calculable.

Two additional observation wells may eventually prove desirable along the canal: one in Wenonah sand, about 3 mi. E. of Summit bridge, and the other in channel fill of the Pleistocene series, just W. of St. Georges. --Delaware Geol. Survey.

1-495. Nace, R. L., I. S. McQueen, and Arthur Van't Hul. RECORDS OF SPRINGS IN THE SNAKE RIVER VALLEY, JEROME AND GOODING COUNTIES, IDAHO, 1899-1947: U. S. Geol. Survey, Water-Supply Paper 1463, 62 p., 2 figs., 2 pls., 1958.

The largest ground-water system in Idaho discharges naturally through springs in the valley of the Snake River in southern Idaho. Records of discharge measurements are scattered widely, chiefly in publications of the Geological Survey. The assembled record, covering the period 1899-1947, brings all available information together in a single volume. --U. S. Geol. Survey.

1-496. Moulder, A. E., and F. A. Kohout. GROUND-WATER FACTORS AFFECTING DRAINAGE IN THE FIRST DIVISION, BUFFALO RAPIDS IRRIGATION PROJECT, PRAIRIE AND DAWSON COUNTIES, MONT.: U. S. Geol. Survey, Water-Supply Paper 1424, 198 p., 51 figs., 11 pls., 1958.

Progressive waterlogging of farmland on the Buffalo Rapids Irrigation Project necessitates measures to reduce recharge and drain excess ground water from the underlying terrace deposits. Specific means, based on a study of the causes of waterlogging in various parts of the area, are suggested for alleviating the condition. Lining the main canal in stretches where leakage is occurring, deepening existing drains, constructing new drains, and installing wells to help relieve artesian pressure are the principal methods proposed. --U. S. Geol. Survey.

1-497. Mundorff, J. C., and P. R. Jordan. FLUVIAL SEDIMENT IN WHITEHEAD WATERSHED AND WHITEHEAD RESERVOIRS, NEBRASKA, APRIL 1955 TO SEPTEMBER 1956: U. S. Geol. Survey, Circ. 406, 21 p., 15 figs., 1958.

Seven periods of significant runoff and outflow occurred at 2 detention dams in the Whitehead Watershed between Apr. 1955 and Sept. 1956. Data on water discharge, sediment discharge, and particle size analyses of suspended sediment of the 2 reservoirs during this period are given. Characteristics of sediment and sediment transport in the watershed are discussed. --U. S. Geol. Survey.

1-498. Robinove, C. J., R. H. Langford, and J. W. Brookhart. SALINE-WATER RESOURCES OF NORTH DAKOTA: U. S. Geol. Survey, Water-Supply Paper 1428, 72 p., 8 figs., pl., 1958.

The report, one of a series being prepared on the saline-water resources of various States, describes the principal saline-water aquifers and surface-water bodies and compiles available analyses. It also gives estimates of quantities of saline water available. A large proportion of the available water supply of North Dakota contains more than 1,000 ppm. of dissolved solids and thus is considered "saline" as that term is used in these reports.--U. S. Geol. Survey.

**1-499.** LaMoreaux, P. E., and others. RECONNAISSANCE OF THE GEOLOGY AND GROUND WATER OF THE KHORAT PLATEAU, THAILAND: U. S. Geol. Survey, Water-Supply Paper 1429, 62 p., 11 figs., 9 pls., 1958.

The Khorat Plateau in Thailand is made up mainly of sandstone and shale beds of Triassic age underlain by shale, sandstone, and limestone of Paleozoic age. Three potential sources of ground water in the area are: (a) soil and bedrock, throughout the area, which will supply water adequate for domestic needs to shallow dug, bored, or drilled wells generally not exceeding 100 ft. in depth; (b) alluvial deposits of sand and gravel, which will supply water adequate for domestic, municipal, and limited industrial and agricultural needs to shallow dug or drilled wells generally not exceeding 100 ft. in depth; and (c) dipping sandstone beds, which will supply water under artesian pressure to drilled wells exceeding 100 ft. in depth.--U. S. Geol. Survey.

## 12. MINERAL DEPOSITS

See also: Geologic Maps 1-293, 1-301; Stratigraphy 1-377; Geophysics 1-434; Geochemistry 1-450, 1-455; Mineralogy 1-464; Miscellaneous 1-540, 1-542.

**1-500.** Riecker, Robert E. GEOLOGIC APPLICATIONS OF FLUORESCENCE: Compass, v. 36, no. 2, p. 85-93, 2 figs., table, Jan. 1959, 12 refs.

Electronic transition resulting from absorption of ultraviolet light produces fluorescence. Differentiation between fluorescence and phosphorescence is based on the lifetime of the transition of an element from the excited state back to its initial energy level. This paper reviews the important uses of fluorescence and suggests several new applications in the fields of petroleum exploration, mining geology, and ground-water studies.

Naturally occurring solids and liquids exhibit a characteristic color when exposed to ultraviolet light, and this characteristic color is used in mineral determination, drill-core analysis, in correlation of oil sands, in prospecting for strategic metals, in differentiation of bitumens and hydrocarbons, in mineralogical bead tests, and in ground-water and sedimentation studies.--Auth.

**1-501.** Maher, Stuart W. THE ZINC INDUSTRY OF TENNESSEE: Tennessee, Dept. Conserv., Div. Geology, Inf. Circ. no. 6, 28 p., 3 figs. incl. index map, 1958, 17 refs.

Since before 1844, over 1.1 million tons of recoverable Zn have been mined from Cambro-Ordovician limestones and dolomites of eastern and central Tennessee. The most important deposits are in the Mascot-Jefferson City and Copper Ridge districts; these occur in the Kingsport formation of Ordovician age. These deposits are Pb-free, low in Fe, and consist of the zinc sulfide, sphalerite. The sphalerite occurs as small veins and disseminated grains in a gangue of white crystalline dolomite filling shattered and broken gray to brown host rocks. Only traces of other minerals are found in the deposits.

Information on mine development, milling, and marketing is given. The economic significance of these deposits is discussed. The Zn-industry potential in Tennessee, as well as future nationwide development of the industry, is forecast. Appendix includes Zn mine and prospect locations.--G. E. Denegar.

**1-502.** Rose, E. R. GORDON LAKE NICKEL DEPOSIT, ONTARIO: Canada, Geol. Survey, Paper 58-6, 14 p., illus., 2 figs.(in pocket), 3 pls., 1958, refs.

These Ni deposits occur in Archaean rocks in northwestern Ontario, 60 mi. N. of Kenora.

Nickeliferous pyrrhotite, pentlandite, chalcopyrite, magnetite, and cobaltite occur disseminated, as irregular stringers, and as bands of massive sulphides mainly in serpentinized peridotite. The ultramafic rocks occur as discontinuous lenses along major easterly-trending fault zones. The country rocks comprise paragneiss, schist, and amphibolitic granulite cut by dioritic, granodioritic, granitic, and pegmatitic rocks. Geological, mineralogical, and geochemical evidence favours a genetic relationship between the deposits and the associated ultramafic rocks.--I. C. Brown.

**1-503.** Beavan, A. P. THE LABRADOR URANIUM AREA: Geol. Assoc. Canada, Proc., v. 10, p. 137-45, fold. geol. map, Dec. 1958, 13 refs.

The Labrador Uranium area embraces roughly 2,500 sq. mi. between Seal Lake area and the Atlantic Coast at Makkovik (55°05'N., 59°11'W.). Much of this belt is underlain by folded sedimentary and volcanic rocks which have been termed Croteau series in the westerly part of the district, and Aillik series on the coast. Since altered quartzite of Aillik type has been traced into an area of Croteau quartzite, the 2 series are considered to be one and the same. They are intruded by granitic stocks, which are larger and more numerous near the coast, by small stocklike and sill-like bodies of syenite and gabbro, and by a variety of mafic dikes.

Croteau-Aillik rocks are bounded by granite, or grade into gneisses, on both the N. and S. flanks of the belt. At the western extremity of the area the Croteau series is in fault contact with rocks of the Seal Lake series, which on balance of present evidence is believed to be the younger.

The area was first prospected in 1951-54, with the discovery of numerous occurrences of chalcopyrite-bornite mineralization in a variety of rock types. In 1954, pitchblende was discovered 10 mi. S. of Makkovik. Subsequent exploration has disclosed radioactive mineralization in all rock types except late mafic dikes. Most occurrences are in quartzitic sediments as fracture fillings, mineralized shatter zones, veining and replacement (?) in minor drag folds, and fault breccia zones. The U mineral is pitchblende, with which are associated calcite, quartz, purple fluorite, minor chalcopyrite, and, commonly, red alteration and yellow oxidation products of U. Two pitchblende occurrences have associated native Ag and Ag-rich sulphide mineralization, respectively. Underground exploration is in progress at one occurrence where mineralization is localized on shears in interbedded argillite and volcanic rocks.

The distribution and variety of radioactive occurrences marks the area as a U metallogenic province, with geological and mineralogical similarities to the Beaverlodge, Saskatchewan, and Great Bear Lake, Northwest Territories, camps. --Auth.

1-504. Shaw, D. M. RADIOACTIVE MINERAL OCCURRENCES OF THE PROVINCE OF QUEBEC: Quebec, Dept. Mines, Geol. Rept. 80, 52 p., 10 col. geol. maps (3 maps and legend in pocket), 2 tables, 1958, 5 refs.

Occurrences of radioactive minerals in Quebec have been known for 50 years or more, but active prospecting did not begin until the late 1940's. Over 40 occurrences are here described, alphabetically by township and property, based on examination during 1954 and 1955.

Introductory notes on the radioactive elements of the earth's crust and radioactive minerals are followed by brief discussion of the geochemistry of U and methods of instrument prospecting for Th and U.

All deposits described in this report are in Precambrian rocks and almost all are in the Grenville sub-province, in an area extending from Sept-Iles on the St. Lawrence Gulf to the Ontario border along the Ottawa River. Rocks containing the deposits are grouped into 3 main categories: a) Grenville series, b) intrusive and related rocks, and c) skarn rocks. The occurrences themselves are classified into 3 groups: a) granite-syenite deposits, b) skarn deposits, and c) molybdenite-rich deposits. Most of the deposits fall into groups a) or b). Description of individual properties is supplemented by colored geologic maps. --A. C. Sangree.

1-505. Malan, Roger C., and Henry W. Ranspot. GEOLOGY OF THE URANIUM DEPOSITS IN THE COCHETOPA MINING DISTRICT, SAGUACHE AND GUNNISON COUNTIES, COLORADO: Econ. Geology, v. 54, no. 1, p. 1-19, 3 figs. incl. geol. map, plan, columnar sec., 2 tables, Jan.-Feb. 1959, 5 refs.

Vein-type U deposits of geologic interest and commercial significance occur in the Cochetopa mining district. The U minerals in these deposits have been precipitated from hypogene solutions probably related to Tertiary igneous activity in the district. Silicification and brecciation of the sedimentary rocks in the Morrison formation and the Dakota sandstone, in and adjacent to fault zones, controlled deposition of U minerals from hydrothermal solutions. The most important deposits in the district are at the Gunnison Mining Company's Los Ochos claims where substantial reserves of ore in pipelike and in vertically tabular bodies have been blocked out. Pitchblende, the dominant U mineral, is associated with abundant clay and minor amounts of marcasite. . As a result of studies carried out in the district, certain pertinent geologic criteria on ore localizing influences have been established. --Auth.

1-506. Johnson, Henry S., Jr., and William Thordarson. THE ELK RIDGE-WHITE CANYON CHANNEL SYSTEM, SAN JUAN COUNTY, UTAH: ITS EFFECT ON URANIUM DISTRIBUTION: Econ. Geology, v. 54, no. 1, p. 119-29, 3 figs. incl. map, Jan.-Feb. 1959, 15 refs.

Reconnaissance in the White Canyon district, San Juan County, Utah, indicates that rocks of the Shinarump member of the Chinle formation of Triassic age were deposited in that district in 2 different channel systems; sediments deposited in channels of one system were derived from a source to the E. and the sediments of the other from a source to the S. The channel system containing sediments derived from the E., the Elk Ridge-White Canyon channel system, was apparently formed by a large braided stream that flowed westward from a source in granitic and metamorphic terrane of the ancestral Uncompahgre highland.

All known U deposits of any consequence in the White Canyon district are confined to the Shinarump member deposited in the Elk Ridge-White Canyon channel system. The nature of the channels and the lithologic characteristics of the rocks filling this system of channels combine to form a much more favorable environment for the localization of U deposits than do the channels formed and the rocks deposited by northward-flowing streams.

Recognition of channel systems in the White Canyon district suggests that channel systems may be recognized elsewhere in the Shinarump member, and that the Shinarump member on the Colorado Plateau may be composed of rocks deposited in many coalescing channel systems. In addition, study in the White Canyon district indicates that rocks deposited in some of these channel systems are more favorable hosts for U deposits than the rocks deposited in others. Recognition and delineation of these ancient channel systems may be of help in making regional appraisals of ore potential and in the search for new mining districts. --Auth.

1-507. Rowe, Robert B. NIOBIUM (COLUMBIUM) DEPOSITS OF CANADA: Canada, Geol. Survey, Econ. Geology Ser. no. 18, 108 p., illus., 40 figs. (3 in pocket) incl. mine plans and camera-lucida drawings, 1958, 86 refs.

Nb, formerly called columbium, is needed to produce the high-temperature alloys used in jet engines. The principal source of Nb is the mineral columbite which is obtained mainly from Nigeria. New sources are required, and other minerals, particularly pyrochlore, are being considered.

Canadian deposits that so far have shown greatest economic possibilities are placer deposits in southern British Columbia derived from granitic rocks and lode deposits associated with alkaline rock complexes. The latter, together with Nb-bearing deposits of other types, are widely distributed in Canada. None is at present producing but some show promise. --H. M. A. Rice.

1-508. Govett, G. J. S. SODIUM SULFATE DEPOSITS IN ALBERTA: Research Council Alberta, Geol. Div., Prelim. Rept. 58-5, 34 p., illus., 1958, 6 refs.

A reconnaissance survey of over 250 lakes in E.-central and S.-central Alberta disclosed several hitherto unrecorded localities where detailed work may indicate the presence of economic deposits. The most important of these is located 7 mi. N. of Loyalist; the brine contains about 12% $Na_2SO_4$, and is underlain by a permanent crystal bed. Analyses are included for Na, K, Ca, Mg, $SO_4$, $CO_3$, $HCO_3$, and Cl for 35 lakes, with $Na_2SO_4$ ranging in concentration from 0 to 17%. --Auth.

1-509. Anon. ASBESTOS PRODUCTION UNDERWAY AT BLACK LAKE: Mining Engineering, v. 11, no. 1, p. 55-57, 5 illus., flowsheet, Jan. 1959.

Lake Asbestos of Quebec's recently-dedicated mining and milling operation has begun output from a lake-bottom deposit that was uncovered only after 55 billion gal. of water were pumped off and 27 million cu. yd. of mud and silt were removed. Open-pit work alone is expected to yield 100,000 tons annually for 20 years. Mining and marketing are covered in the discussion, and milling operations are included. --Auth.

1-510. Yi-Ming, Sun. CHARACTERISTICS OF CHINESE ASBESTOS AND ITS PRODUCTION: Canadian Mining Jour., v. 79, no. 12, p. 62-64, illus., 2 tables, Dec. 1958.

The asbestos mining and manufacturing industries of China have expanded since 1949. The nationwide geological survey carried out during the past few years has shown that the country is rich in asbestos resources, much of which is of high quality.

Most asbestos deposits discovered and mined in China are located in a belt extending from the seacoast of Liaoning Province, NE. China, to SW. China, passing through Inner Mongolia. In general, the deposits occur in the form of veins as much as 2 m. thick and separated quite irregularly from each other. Some deposits are worked in open pits; others are reached by tunnels and shafts.

All varieties of asbestos of commercial value are found in China. These include crocidolite, amosite, and chrysolite. Production statistics are given. --G. E. Denegar.

1-511. Deadmore, D. L., and J. S. Machin. SOME PLASTIC PROPERTIES OF PASTES MADE FROM HYDRATED DOLOMITIC AND HIGH-CALCIUM LIMES: Illinois, State Geol. Survey, Circ. 261, 9 p., 3 figs., 2 pls., 7 tables, 1958, 5 refs.

Four commercial hydrated limes were studied. Two from northwestern Ohio were partially hydrated dolomitic varieties that gave instantaneous Emley plasticity values of about 120. After soaking, the Emley values increased to about 310. One Illinois hydrate was a high-Ca hydrate and had a plasticity of about 100, both immediately before and after soaking. The other Illinois hydrate was a highly hydrated dolomitic type. Its immediate plasticity was 274 and, after soaking, the value rose to 340.

A study of particle-size distribution data and x-ray diffraction analysis show that the differences in the observed plasticities are correlated with high $Mg(OH)_2$ content and high relative amounts of fine particles. --Auth.

1-512. Sargent, Hartley. THE MINERAL INDUSTRY AND B.C.: Engineering Jour., v. 41, no. 11, p. 58-60, 5 illus., Nov. 1958.

The 1858 gold rush to British Columbia's placer deposits forced construction of roads, inland waterways, and railroads, which in turn led to lode mining, not only of Au, but also of ores containing Cu, Ag, Pb, Zn, and by-product metals. In 100 years, British Columbia has produced minerals with a gross value of almost $4 billion, of which placer gold mining has recovered $96 million. Almost half the placer gold was recovered in the first 25 years.

By 1957, the list of raw materials produced in British Columbia included 12 metals, 12 structural materials, 9 industrial minerals, and 3 fuels. For the past 10 years, the annual values of produced raw materials have averaged $162 million. --G. E. Denegar.

1-513. Quebec (Province), Dept. of Mines. AN OUTLINE OF GEOLOGY AND EXPLORATION WORK ON MINING PROPERTIES IN QUEBEC IN 1954 AND 1955 (EXCLUSIVE OF PRODUCING MINES): Its: Prelim. Rept. no. 374, 49 p., 1958.

Summary descriptions are given of the geology and progress of exploration and development on 63 mining properties in the Province of Quebec, based on examinations made in 1954 and 1955. For the most part, descriptions in this report are of properties that have not reached the production stage. Descriptions of occurrences of radioactive minerals are published in the Quebec Dept. of Mines, Geological Report 80, by D. M. Shaw, q. v. --A. C. Sangree.

1-514. Davis, Fenelon F., and Harold B. Goldman. MINES AND MINERAL RESOURCES OF CONTRA COSTA COUNTY, CALIFORNIA: California Jour. Mines & Geology, v. 54, no. 4, p. 501-83, illus., 6 figs., col. geol. map, scale 1 in. to 1 mi. (in pocket), tabulation of mineral deposits, Oct. 1958, 107 refs.

Contra Costa County, in the Coast Ranges of central California, lies NE. of San Francisco and Oakland in the San Francisco Bay area. Its 734 sq. mi. include land as low as the delta and tidal flats along San Francisco Bay to mountains as high as Mount Diablo, some 3,849 ft. above sea level. Rocks typical of the central Coast Ranges, ranging in age from Upper Jurassic to Recent, are exposed in the county; on the flanks of Mount Diablo, exceptionally thick sections of Cretaceous and Tertiary rocks may be seen. Mount Diablo itself is a plug of Franciscan (Upper Jurassic) ultrabasic igneous, sedimentary and metamorphic rocks which has been thrust upward through the overlying Cretaceous rocks. The Cretaceous and Tertiary strata of the county have been compressed into a series of NW.-trending folds well exposed near Mount Diablo, and in the hills between the mountain and San Francisco Bay.

The value of the total recorded mineral production for the county, 1894-1956, is $98,641,031. During 1956, mineral production was valued at $5,184,878, ranking the county twenty-second among California's 58 counties. The mineral commodities produced during 1957 were clay, natural gas, peat, sand, stone, and sulfur and hydrogen sulfide gas from petroleum refineries. In the past, substantial quantities of cement, coal, mercury, and mineral water were marketed as well as small amounts of pumice.

Stone quarries in Contra Costa County have for many years supplied crushed rock, riprap, and fill material for the construction industries of the East Bay area. Eight quarries and rock plants were operating during 1957, producing sandstone and metavolcanic rock from the Franciscan group (Upper Jurassic), volcanic rock from the Moraga formation (Pliocene), and sandstone from the Monterey and San Pablo groups (Miocene).

The Henry Cowell Lime and Cement Company operated a cement plant SE. of Concord from 1909 to 1946, using travertine-limestone and clay mined on nearby Lime Ridge. The plant was closed when the limestone deposits were depleted.

An estimated 3,500,000 tons of sub-bituminous coal was mined from the Domengine formation (Eocene) in the northern foothills of Mount Diablo before the mines were closed in 1902. Competition from petroleum products forced the cessation of coal mining.

Mercury production has been intermittent since about 1875, the Mount Diablo mine being the only producer. Total recorded production was over 11,000 flasks, most of which was produced between 1938 and 1946. This deposit is associated with hydrothermally altered serpentine of the Franciscan group, and is unique in having metacinnabar as an abundant primary mineral.

Large quantities of clay shale, suitable for use in the manufacture of face and common brick and cement, have been mined from Jurassic, Cretaceous, and Tertiary strata. Virtually unlimited reserves of this type of material are available. Two brick plants have been operating continuously for many years using clay mined in the county.

Natural gas from Eocene sands underlying the northeastern part of the county is produced from 7 wells, which tap the southern end of the productive structure of the Rio Vista gas field, the largest dry natural gas field in California.

Sand for use in asphalt plants is mined from sand dunes of Recent age, east of Antioch along the S. bank of San Joaquin River. Sandstone of the Domengine formation, which crops out on the NE. flank of Mount Diablo, was mined for glass sand and clay-free foundry sand; and, in the past, large quantities were mined S. of Brentwood for glass manufacturing. Seven sand properties were producing in 1957.

An extensive mineral processing industry is centered in the county. Petroleum refining is the leading industry; refineries are at Richmond, Oleum, Martinez, and Associated. The only lead smelter on the Pacific Coast is operated at Selby by the American Smelting and Refining Company. Refractories are manufactured at Pittsburg from California clays. At Richmond, mineral wool is produced from copper slag: pyrite is roasted and the sulfur dioxide gas is recovered for the manufacture of sulfuric acid. The furnace calcine from the latter operation is stockpiled for the ultimate recovery of gold and silver it contains in small quantities. --Auth.

**1-515.** Schoewe, Walter H. THE MINERAL INDUSTRY IN KANSAS IN 1957: Kansas, State Geol. Survey, Bull. 130, 1958 Repts. of Studies, pt. 6, p. 193-242, fig., 2 maps, 41 tables, Dec. 1958, 17 refs.

In 1957, for the second consecutive year, the value of Kansas mineral production exceeded $500,000,000. Minerals produced in the state were valued at $534,093,085, or approximately $19,222,000 more than in 1956, a gain of 3.7%. Of this total, $467,151,147 or 87.5% was derived from sale of mineral fuels and associated products, $62,945,148 or 11.6% was contributed by the nonmetals excluding mineral fuels; and $4,896,790 or 0.9% by the metals. Only natural gas and hydrocarbon liquids were produced in greater quantity in 1957 than in the previous year. Crude oil, raw clay, natural gas, natural gas liquids, and common salt were worth more, however, than in 1956.

Only 3 of the 105 counties in Kansas reported no mineral production in 1957. Oil, gas, or both were produced in 80 counties, sand and gravel in 70 counties, and stone in 43 counties. In 1957, each of 54 counties produced minerals worth $1,000,000 or more. As in previous years, Barton County, with a production value of $41,345,547, continued to lead all others. Ellis County, with $36,178,679, was second, and Russell County, with $28,573,560, was third. Only seven of the counties producing $1,000,000 or more in mineral wealth in 1957 produced mainly nonfuel minerals, and 6 of these are in eastern Kansas. The counties that produced the greatest dollar value of minerals are those in which oil is found, mainly western Kansas counties. Counties that exploited the most different minerals were Cherokee, Rush, and Sedgwick. Most important minerals produced in Kansas were oil, natural gas, cement, natural gas liquids, stone, clay and clay products, salt, sand and gravel, carbon black, zinc, coal, and lead. This report gives the production and value of all minerals produced in the state in 1957 and compares them with 1956, and it also includes directories of mineral producers on record as of December 31, 1957. --Auth.

**1-516.** Austin, Muriel B., and Arthur M. Hussey, II. MAINE GRANITE QUARRIES AND PROSPECTS: Maine Geol. Survey, Minerals Resources Index no. 2, 50 p., 42 map pls., fold. index map, May 1958.

This booklet is intended to serve as a fairly complete inventory of granite quarries which are being or have been operated in Maine. Included in continuous list form are the names and locations by town, county, and U.S.G.S. quadrangle, of more than 160 quarries. For most, a mineralogical and textural description of the rock type is given; for some, modal analyses are given. Lists of buildings, bridges, monuments, and other structures in which specific granites were used are also included. Forty-two black-and-white plates show locations accurately at a scale of about 1 in. to 1 mi. An index map, approx. scale 1:1,000,000, shows locations statewide on a minor civil-division base. --J. R. Rand.

**1-517.** Rand, John R. MAINE METAL MINES AND PROSPECTS: Maine Geol. Survey, Minerals Resources Index no. 3, 53 p., 23 maps (1 in pocket), June 1958, 31 refs.

More than 350 reported occurrences of metallic mineralization in Maine are located either by township or on detailed geologic maps. Metals include Mn, Fe, W, Cu, Pb, Zn, Ni, Ag and Au. These are briefly described. With few exceptions, occurrences listed have never produced important quantities of metals. --G. E. Denegar.

# 13. FUELS

See also: Geologic Maps 1-292; Areal and Regional Geology 1-345; Geophysics 1-437; Geohydrology 1-487, 1-488.

**1-518. Clifford, O. C., Jr. A HARD LOOK AT OUR PROFESSION: OIL FINDING: Geophysics, v. 23, no. 5, p. 930-41, Dec. 1958.**

Statistics are quoted to show that the success ratio of technically guided test wells is actually decreasing in recent years. Lack of cooperation between geophysicists and geologists is blamed, and suggestions made for improving the situation. --D. B. Vitaliano (courtesy Geophysical Abstracts, 176).

**1-519. Dickey, Parke A. THE FIRST OIL WELL: Jour. Petroleum Technology, v. 11, no. 1, p. 14-26, illus., 3 ports., 2 facsims., diag., graph, Jan. 1959, 34 refs.**

The birth of the oil industry on Aug. 27, 1859, was spectacular, and its later history has been colorful and romantic.

During the early part of the last century the industrial revolution was in full swing. The demand for oil for lubricating the machinery and illuminating the factories had been supplied from tallow and whale oil. In the 1850's an industry based on the production of illuminating oil from coal was growing rapidly, and a refining technology utilizing thermal cracking and distillation was well-developed. It was soon found that petroleum was superior to coal as a raw material, but it was a scientific curiosity, occurring in many places, but in small quantities.

At the same time, along the tributaries of the Ohio River, a considerable industry had grown up around the manufacture of salt. The brine was obtained from sands at depths up to 1,000 ft. A drilling technology had developed, and the methods of cable tool drilling were mostly invented between 1800 and 1830 along the Kanawha, Muskingum, Conemaugh, and Allegheny rivers.

Petroleum was produced along with the brine at nearly all the salt manufacturing plants. At most of these it was used to illuminate the plants and grease the machinery. It was inevitable that this new source of oil should come to the attention of the coal-oil refiners, and that attempts should be made to produce oil by drilling. The combination of a large and growing demand for oil, a well-developed refining industry, and a highly developed drilling technology provided an explosive mixture.

The spark finally occurred at Titusville, Pennsylvania, on the site of a famous oil seep that had been exploited by the Mound-builders and later by the Seneca Indians and the early settlers. Two New York promoters, George H. Bissell and Janathan G. Eveleth, formed a company which purchased the farm on which the seeps were located. They were unable to sell stock until they published a glowing report on the commercial value of the oil written by Benjamin Silliman, Jr., a famous chemist and professor at Yale University. Financial support was finally obtained from James M. Townsend, a New Haven banker, and his associates.

Edwin L. Drake went to Titusville in Dec. 1857 to start operations for the company. The first year he opened up the old springs and attempted to exploit them. He decided to drill for oil and employed a salt-well driller, W. A. Smith, who came to Titusville in the spring of 1859. Oil was encountered on Aug. 27 at the unexpectedly shallow depth of 69 ft. The well produced about 10 B/D. Land along the creek valleys was quickly leased, and drillers, teamsters, coopers, speculators and others flocked to the area. The excitement exceeded that of the California gold rush 10 years before.

By the end of 1859, 3 more wells had been drilled and, by the end of 1860, 74 wells were producing. The excitment increased in 1861 when the first flowing wells produced thousands of barrels a day. These flooded the market completely and the price fell disastrously. Since then the industry has repeated the pattern of boom and over-production, but eventually the demand has always caught up with the supply. --Auth.

**1-520. Power, Harry H. ONE HUNDRED YEARS OF PROGRESS IN PETROLEUM PRODUCTION: Jour. Petroleum Technology, v. 11, no. 1, p. 11-13, Jan. 1959.**

A comparison of petroleum-production engineering practices in the U. S. from before 1860 to the present briefly treats early exploration, drilling development, petroleum exploitation, reservoir engineering, potential production engineering practices, unproved-recovery methods, and conservation. Also included is a brief history of the Society of Petroleum Engineers. --G. E. Denegar.

**1-521. McGrain, Preston. SERVICES OF THE KENTUCKY GEOLOGICAL SURVEY TO THE OIL AND GAS INDUSTRY (In: McGrain, Preston, and Thomas J. Crawford, eds. PROCEEDINGS OF THE TECHNICAL SESSION, KENTUCKY OIL AND GAS ASSOCIATION, TWENTY-SECOND ANNUAL MEETING, JUNE 5-6, 1958): Kentucky Geol. Survey, Spec. Pub. 1, Ser. 10, p. 43-47, fig., 1958.**

The Kentucky Geological Survey is a research and service organization whose functions include compilation, interpretation, and dissemination of data relative to the oil and gas resources of the State. Data which may be inspected by or distributed to oil and gas geologists and operators and other interested parties include areal geologic, structure, oil and gas, and topographic maps; reports on oil pools, regional surface and subsurface studies, and development compilations; driller's logs, electric logs, and sample descriptions; and sets of drill cuttings. Without increased appropriations for an enlarged staff and laws requiring the filing of exploratory data, facilities and services cannot be expanded materially in the future. --Auth.

**1-522. Cheney, Theodore Albert. AIRPHOTOS IN THE MINERAL FUELS INDUSTRY (In: McGrain, Preston, and Thomas J. Crawford, eds. PROCEEDINGS OF THE TECHNICAL SESSION, KENTUCKY OIL AND GAS ASSOCIATION, TWENTY-SECOND ANNUAL MEETING, JUNE 5-6, 1958): Kentucky Geol. Survey, Spec. Pub. 1, Ser. 10, p. 63-71, 1958.**

Airphotos can be used in a number of ways to save both time and money in the mineral fuels industry. Airphoto analysis has useful applications for both the geologist and the engineer. The analysis is a systematic study of airphotos in order to obtain geologic and soil information. This system is predicated on the fact that there are recognizable patterns on airphotos developed as a result of all the natural processes. These patterns are described in terms of 5 factors: topography, drainage, erosion, tone, and vegetation. A knowledge of the "normal" patterns developed by various rock and soil types allows the trained analyst to identify the "abnormal" patterns which are often of more economic importance than "normal" land forms. Faults, fractures, folds, etc. are here considered to be abnormalities for the sake of discussion.

The author mentions several possibilities for research in the combined fields of geology and airphoto analysis. One phenomenon, that of tonal anomalies, is indicated as needing more research work. The author wonders if perhaps the airphotos are actually giving more information about the microstructure of a rock than do the unaided eyes of a man examining a hand specimen.

Photogrammetry is mentioned as making possible maps which are more rapidly, more accurately, and more secretly compiled than those compiled by the normal ground methods of map-making. In summary, the author contends that airphotos can be extremely useful to geologists and engineers from the initial planning stages through the exploration phase and into the operational phases of the mineral fuels industry. --Auth.

**1-523. Cook, John C. SOME UNORTHODOX PETROLEUM EXPLORATION METHODS: Geophysics, v. 24, no. 1, p. 142-54, 2 illus., map, 2 tables, Feb. 1959, 21 refs.**

Over a period of 3 years, more than 100 new or little-known methods of seeking underground petroleum deposits were impartially evaluated. Most of these methods were the products of independent inventors. A large proportion of the methods proved to have little or no scientific foundation; nevertheless, the protagonists were afforded ample opportunity to prove the value of the methods by field performance. The results with every such method on which adequate data were accumulated were either negative or inconclusive.

The methods which possessed some degree of technical merit included a few worthy of careful scientific study. These belonged to the general fields of seismic improvements, geochemical and radioactivity techniques, and electrical techniques. Some of these methods have received a degree of attention from laboratories of major oil-producing companies. Several examples of unorthodox methods are described. Scientifically trained persons can often detect fallacious methods by the protagonists' gross misuse of technical language. However, a study of the principles involved and statistically valid field testing are more conclusive. --Auth.

**1-524. Gorrell, H. A. IMPORTANCE OF SUBSURFACE WATER DATA IN PETROLEUM GEOLOGY: Canadian Mining & Metall. Bull., v. 51, no. 560, p. 754-58, 2 figs., Dec. 1958, 14 refs.**

Subsurface water data can be very valuable in petroleum exploration and research. For the discussion of problems related to subsurface waters, uniform nomenclature and classification are required. The term "connate water" has frequently been incorrectly used. It should only be used in its original sense in which it is analogous to "fossil water." Classification based on origin and on sodium chloride content are proposed.

Present and possible uses of formation-water analyses are briefly discussed. Since the potential uses of formation-water data are not fully understood, complete analyses of selected samples should be made to insure against future requirements.

The subsurface waters of Alberta show considerable regional variation in amount and proportion of dissolved salts. --Auth.

**1-525. Street, Norman. ELECTROKINETICS. I.-ELECTROVISCOSITY AND THE FLOW OF RESERVOIR FLUIDS: Illinois, State Geol. Survey, Circ. 263, 18 p., 6 figs., table, 1959, 22 refs.**

Liquids flowing through narrow capillaries frequently exhibit a viscosity that is higher than normal; usually it is high for low-conductivity liquids but is low for very conductive liquids or concentrated solutions. This effect may have some influence on the flow of oil and water through petroleum reservoirs, although little note has yet been taken of the possibility.

The theory underlying this electroviscous effect is simply developed and some calculations as to its order of magnitude are presented. An equation is given for the electroviscous effect in 2-phase flow through a "Yuster" model. --Auth.

**1-526. Pate, J. Durwood. STRATIGRAPHIC TRAPS ALONG NORTH SHELF OF ANADARKO BASIN, OKLAHOMA: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 1, p. 39-59, 19 figs. incl. isopach & struct. maps, cross-secs., Jan. 1959, 6 refs.**

Extensive stratigraphic accumulations of oil and gas along the northern shelf of the Anadarko basin have been the visions of petroleum geologists for more than 2 decades; however, only recently have these visions become a reality. Discoveries of important oil and gas reserves in the Laverne, SE. Stockholm, Woodward, and the "Cherokee trend" fields have focussed the attention of all exploration men on the stratigraphic trap possibilities of the northern shelf area.

Early exploration along the shelf consisted of surface mapping, core drilling, and geophysical surveying. Test wells, drilled without the aid of gas detectors and modern methods of surveying the bore hole, penetrated many gas reservoirs which were unrecognized and therefore not evaluated.

Many stratigraphic trap possibilities in most of the Paleozoic sediments ranging in age from Silurian-Devonian into early Permian can now be recognized through the information obtained from the numerous deep tests which have been drilled along the shelf area and in the basin proper. With the rapid advancement made by research in recent years, the geologist now has more sensitive tools with which to discover and evaluate reservoirs of oil and gas in wildcat tests.

Convergence due to truncation and onlap, and interruption in deposition of sands and "reef-type" limestones, provide most of the stratigraphic traps of the northern shelf area. A detailed study of multiple traps in the Laverne district has been made in order to study their nature. Here, one well may have as many as 4 gas reservoirs.

Major reserves of oil and gas are present along the northern shelf of the Anadarko basin, and undoubtedly will be found by those who are adept in delineating stratigraphic traps. --Auth.

**1-527. Cieslewicz, Walter J. A THERMODYNAMIC APPROACH TO THE ORIGIN OF PETROLEUM: Compass, v. 36, no. 2, p. 94-103, table, Jan. 1959, 5 refs.**

In recent Russian literature on the origin of petroleum, considerable attention is given to thermodynamics. At least one major school of thought attempts to resolve many problems in the theory of organic origin by application of thermodynamic principles. Thermodynamics is concerned with changes of energy in a system. Energy can be converted to heat or to work. Every chemical substance has a definite level of free (available) and entropic (unavailable) energy. Living organisms utilize solar energy, in photosynthetic and metabolic processes, to form compounds with progressively higher degrees of free energy saturation. However, these substances are thermodynamically unstable in natural conditions. Thermodynamic laws state that all reactions which occur spontaneously must always proceed toward reduction of the free-energy level.

Accordingly, upon death, organic matter undergoes spontaneous decomposition into products with lower free-energy saturation. This process, if completed, results in the formation of thermodynamically stable inorganic compounds which have zero values of free energy. However, burial of organic remains within the sediment can, under favorable external conditions, arrest this process at various stages of completion. This gives rise to a system of buried organic matter with a high degree of free-energy saturation. Spontaneous reactions continue within such unstable systems and have 2 different effects: (1) further reduction of free-energy level and (2) redistribution of the remaining free energy. Under favorable conditions, this energy redistribution can lead to formation of hydrocarbons. The specific composition of hydrocarbon mixtures is a function of thermodynamically determined reactions. At the same time, that part of the free energy which is converted to work supplies the motive force resulting in migration and accumulation.

Therefore, from a thermodynamic viewpoint, buried organic matter constitutes a system with adequate reserves of internal energy to promote and complete all chemical reactions necessary to alter the organic source material to energy-saturated hydrocarbons. External factors such as reducing environments, state of dispersion, presence of mineral catalysts, and increases in temperature and pressure, can merely activate this inherent potential of the system. --Auth.

1-528. Alberta, Oil and Gas Conservation Board. REPORT TO THE LIEUTENANT GOVERNOR IN COUNCIL WITH RESPECT TO THE APPLICATIONS UNDER THE GAS RESOURCES PRESERVATION ACT, 1956, OF: ALBERTA AND SOUTHERN GAS CO., LTD., AND WESTCOAST TRANSMISSION COMPANY LIMITED: variously paged, 18 figs. incl. 2 maps, graphs, 27 tables, [Edmonton? ], Sept. 1958.

Findings are given in matters of established gas reserves, of trends in exploration and the growth of gas reserves, and of the present and future requirements of Alberta for gas and the present export commitments. Appendices include gas-reserve calculations, also presented graphically; extrapolations of future production and requirements; and comparisons of growth in energy fuel requirements for Ontario and Quebec. --G. E. Denegar.

1-529. Benson, D. C. NATURAL GAS DEVELOPMENT IN WESTERN KENTUCKY (In: McGrain, Preston, and Thomas J. Crawford, eds. PROCEEDINGS OF THE TECHNICAL SESSION, KENTUCKY OIL AND GAS ASSOCIATION, TWENTY-SECOND ANNUAL MEETING, JUNE 5-6, 1958): Kentucky Geol. Survey, Spec. Pub. 1, Ser. 10, p. 72-74, 1958.

Natural gas has contributed more than any other factor to the progress of industrial development and improvement in the standard of living in western Kentucky. Between 1953 and 1957 investment in new industries and expansion of existing industries which use natural gas totaled 590 million dollars.

During the early history of gas development in western Kentucky it appeared that the region would be a major source of natural gas. However, the known fields were soon depleted and it was determined that it would be more feasible to seek an out-of-state supply of gas than to develop new fields in western Kentucky. Local development was adversely affected and soon declined to the vanishing point. Depleted fields were used for gas storage.

Natural gas can still be produced in western Kentucky. This production is especially desirable because: it is located close to the market, making it readily available; an increase in prices of gas from out-of-state sources has increased the purchase price of local gas, thereby making payout and profit margin more profitable for small reserves; and, many of the small gas fields of western Kentucky are quite adaptable for gas storage upon depletion. Two of the most promising, still unexplored formations for gas production in western Kentucky are the Knox dolomite and the Mt. Simon sandstone. The trend toward deeper drilling will undoubtedly lead to the exploration of these. --Auth.

1-530. Lang, Walter B. THE ORIGIN OF SOME NATURAL CARBON DIOXIDE GASES: Jour. Geophys. Research, v. 64, no. 1, p. 127-31, 3 tables, Jan. 1959, 18 refs.

Natural carbon dioxide gas issues from vents and springs in sedimentary rocks. Exploratory wells drilled for oil have produced large volumes of carbon dioxide in subsurface. Where these gases are found in quantity, limestones and igneous rocks are in close association and the origin of the gases is thus suggested. Until the advent of the mass spectrometer there was no means to investigate this problem. Gas samples were taken from representative areas and the analyses showed that the gases were derived from limestone. The isotopic ratios did not give evidence of fractionation. --Auth.

1-531. Bell, Alfred H., Virginia Kline, and Carl W. Sherman. PETROLEUM INDUSTRY IN ILLINOIS IN 1957. PART I. OIL AND GAS DEVELOPMENTS. PART II. WATERFLOOD OPERATIONS: Illinois, State Geol. Survey, Bull. 85, 115 p., 8 figs., 15 tables, 1959.

Illinois produced 76,649,000 barrels of oil in 1957, a decrease of 7% from the 82,314,000 barrels produced in 1956; the decrease marks a change in trend following 3 years of steadily increasing production beginning in 1954. The 2,585 wells completed in 1957 represent a 29% decrease from the 3,640 wells drilled in 1956. The decrease in production was due partly to decline in drilling but mostly to refinery strikes during the summer which forced temporary shut-downs in some pools.

Forty-one % of the 1957 completions were successful. Fifteen new oil pools, one gas pool, 51 extensions to pools, and 16 new pays were discovered in 1957.

Reserves are estimated at 667.3 million barrels on Jan. 1, 1958, 34.3 million barrels below the estimate for Jan. 1, 1957.

During 1957 a total of 382 controlled waterflood projects were reported in operation in Illinois. Waterflood oil produced from these projects was approximately 34,300,000 barrels with an additional 1,750,000 barrels of oil estimated to have been produced from "dump" floods. This total of 36,050,000 barrels of waterflood oil represents some 47% of Illinois' 1957 oil production. Cumulative total of waterflood oil produced at the end of 1957 was 169,250,000 barrels. --Auth.

**1-532.** Hennessy, G. J. GEOLOGY AND DEVELOPMENT OF OAK HILL WEST POOL, HOPKINS COUNTY, KENTUCKY (In: McGrain, Preston, and Thomas J. Crawford, eds. PROCEEDINGS OF THE TECHNICAL SESSION, KENTUCKY OIL AND GAS ASSOCIATION, TWENTY-SECOND ANNUAL MEETING, JUNE 5-6, 1958): Kentucky Geol. Survey, Spec. Pub. 1, Ser. 10, p. 75-82, 2 figs., 1958.

The Oak Hill West oil pool is in Hopkins County, Kentucky, on the southwestern rim of the Illinois basin. Accumulation of oil is in a stratigraphic trap on the flank of an anticlinal flexure which has a fault closure on the S. Of the 20 producers in the pool, 18 produce from the Tar Springs, one from the Ohara, and one from the Rosiclare, all Mississippian horizons. Most of the wells have been completed by shooting and have responded well to this treatment.

There are 230 productive acres of Tar Springs sand with a net pay thickness of 13 ft. Primary recovery reserves are estimated to be 448,500 barrels from the Tar Springs, 20,000 from the Ohara, and 40,000 from the Rosiclare. Future production from the Ohara is promising. Other horizons that warrant further testing are the Hardinsburg sand, the Upper Paint Creek lime, and the Benoist sand. --Auth.

**1-533.** Milhous, H. C. GENERAL GEOLOGY AND HISTORY OF OIL AND GAS DEVELOPMENT IN NORTHERN TENNESSEE (In: McGrain, Preston, and Thomas J. Crawford, eds. PROCEEDINGS OF THE TECHNICAL SESSION, KENTUCKY OIL AND GAS ASSOCIATION, TWENTY-SECOND ANNUAL MEETING, JUNE 5-6, 1958): Kentucky Geol. Survey, Spec. Pub. 1, Ser. 10, p. 53-62, 2 figs., 1958, 2 refs.

The purpose of this paper is to outline the general geology and the past history of attempts to find oil and gas in the northern part of Tennessee, but with only brief mention of the E. and W. Tennessee areas. By far the greatest number of test wells have been drilled in middle Tennessee, while only scattered attempts have been made to find production in the other two sections. --Auth.

**1-534.** Yaskovich, B. V. NOVYYE DANNYYE O NALICHII BITUMOV V PORODAKH KEMBRIYA YUZHNOY FERGANY [NEW DATA ON THE OCCURRENCE OF BITUMEN IN CAMBRIAN ROCKS OF SOUTHERN FERGANSKAYA-DOLINA]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 2, p. 107-109, 2 tables, 2 refs.

This is a short report on the occurrence of bitumen in Cambrian deposits of southern Ferganskaya-Dolina [Fergana lowland; 40°50'N. 71°30'E.]. Bituminiferous rocks are widespread in this region. The dark limestones are especially heavily impregnated, and by breaking them oil can be smelled. The bituminiferous rocks belong mostly to the Middle Cambrian period. The presence of bitumen in such large quantities makes it a possible oil producer. It also indicates the necessity of further exploration of this region for possible oil-bearing formations. --LC.

**1-535.** Marshall, C. E. PETROLOGY AND PREPARATION OF CERTAIN (PERMIAN) COAL SEAMS OF INDIA: Econ. Geology, v. 54, no. 1, p. 20-56, 12 figs., 7 pls. incl. photomicrographs, 10 tables, Jan.-Feb. 1959, 34 refs.

The petrological characteristics of many of the Permian coal seams of India have a profound and particular influence upon their preparation and utilization properties. Relatively high proportions of ash are largely derived from the finely dispersed sedimentary mineral matter generally present in all coal types. The proportions of the clastic minerals generally increase with those of the "inert" seam constituents and are thus generally greatest in the common "dull" coals. The intimate association of fine mineral matter and "inert" organic constituents in both macroscopic and microscopic bands makes the problems of preparation more difficult.

Reduction in the proportions of clastic mineral matter inevitably lowers the content of the "inerts" and thus increases those of the "coking" constituents. Consequently the characteristics of the coke produced vary considerably with the degree of cleaning achieved on the coal. Substantial reduction in the clastic mineral content of the coal charge could be accompanied by significant deterioration in the mechanical strength of the coke produced. --Auth.

**1-536.** Crawford, Thomas J. COMPILATION OF COAL AND PETROLEUM PRODUCTION DATA FOR KENTUCKY: Kentucky Geol. Survey, Rept. Inv. 1, Ser. 10, 43 p., 6 figs., 1958, 6 refs.

Coal and oil have long been the primary mineral products of Kentucky. This report brings together, under one cover, the statistical records of coal and oil production in the State.

The U.S. Bureau of Mines estimates the original reserves of coal in Kentucky at 123,327 million short tons. Approximately 2,543 million tons have been mined since 1828. Almost 80% of this has come from 8 counties: Harlan, Hopkins, Pike, Letcher, Muhlenberg, Perry, Floyd, and Bell.

Cumulative production of oil in Kentucky, from 1918 through 1957, is 335,710,778 barrels: 184,678,678 from western Kentucky; 31,040,972 from central Kentucky; and 119,991,118 from eastern Kentucky. Approximately 85% of the oil has come from 11 counties: Lee, Henderson, Union, Ohio, Daviess, Magoffin, Johnson, McLean, Estill, Webster, and Lawrence, listed in order of decreasing total cumulative production. --Auth.

## 14. ENGINEERING GEOLOGY

See also: Geophysics 1-447; Fuels 1-520.

1-537. Hollis, Edward P. BIBLIOGRAPHY OF ENGINEERING SEISMOLOGY: 2d ed., 144 p., San Francisco, Earthquake Engineering Research Institute, 1958.

Over 2000 briefly-annotated entries and cross-references are classified under 4 main headings: miscellaneous sources of data; geology, geodesy, and seismology; seismometry and dynamics of structures and soils; and design and construction in seismic regions. Each main section is further subdivided by subject. An author index is provided. This rèvision of the preliminary 1954 edition includes references to material published after 1954 and attempts a more comprehensive treatment of publications originating outside the United States. In both editions it appeared essential to include references to literature other than that directly treating the dynamic behavior of structures. --G. E. Denegar.

1-538. Hartman, Howard L. BASIC STUDIES OF PERCUSSION DRILLING: Mining Engineering, v. 11, no. 1, p. 68-75, 12 figs. incl. illus., graphs, Jan. 1959, 9 refs.; also pub. in: Am. Inst. Mining, Metall. & Petroleum Engineers, Trans., v. 214, 1959.

Some of the basic concepts of penetrating rock by impact are outlined, including the mechanism of rock failure, steps in crater formation, blow dynamics, and blow indexing. A mathematical analysis of the effect of blow energy on crater dimensions, is conducted for various bit shapes. Formulas to calculate rate of penetration in percussion drilling are summarized. --Auth.

## 15. MISCELLANEOUS

1-539. Roliff, W. A. PRESIDENTIAL ADDRESS: RETROSPECT AND PROSPECT: Geol. Assoc. Canada, Proc., v. 10, p. 9-18, 6 figs., Dec. 1958.

In 11 years, the Association has increased its membership from 140 to 470 geologists and those interested in the advancement of the geological sciences, it has published 87 geologic papers, it has held 12 meetings, and it has a library of 800 books. Much has been done toward encouragement and promotion of the mineral industry. Future considerations include increased membership, possible affiliation with local geologic organizations, and attainment of a professional status for geologists. A Geological Association of Canada medal to stimulate interest in the presentation and publication of technical papers is proposed. One suggestion for a possible headquarters for the Association is briefly explored. Also presented are statistics on membership, subject breakdown of the 87 papers published, and a financial report. --G. E. Denegar.

1-540. Rand, John R., and Muriel B. Austin. COMMERCIAL ROCKS AND MINERALS OF MAINE: Maine Geol. Survey, 18 p., map, 18 mineral specimens, Jan. 1959.

Limited edition of 250 copies, designed as a teaching aid in schools, was distributed exclusively to public and parochial high schools, academies, and preparatory schools throughout Maine. The booklet describes briefly what a mineral is, what a rock is, and what a geologist is and does. The remainder of the text describes 18 commercial rocks and minerals of Maine, their composition, their mode of origin or formation, and their commercial uses. A 4-color map, scale 1 in. to 31 mi., shows counties, highways, and mine, pit, or quarry locations throughout the State. Samples of each of Maine's commercial or potentially commercial minerals are provided. --J. R. Rand.

1-541. Anon. LITERATURA PO GEOLOGII I SMEZHNYM DISTSIPLINAM POSTUPIVSHAYA V BIBLIOTEKU OTDELENIYA GEOLOGO-GEOGRAFICHESKIKH NAUK AN SSSR ZA NOYABR 1957 G. [LITERATURE ON GEOLOGY AND RELATED DISCIPLINES RECEIVED BY THE LIBRARY OF THE SECTION OF GEOLOGICAL-GEOGRAPHICAL SCIENCES OF THE ACADEMY OF SCIENCES OF USSR DURING NOVEMBER 1957]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 2, p. 127-34.

This list contains 171 references to articles published in Soviet periodicals during Nov. 1957. These references are categorized as follows: geology - 53 articles; paleontology - 5 articles; petrography, mineralogy, crystallography, geochemistry - 46 articles; useful minerals and the methods of prospecting and research - 29 articles; hydrogeology, geological engineering - 15 articles; miscellaneous - 23 articles. --LC.

1-542. Alberta, Dept. of Mines and Minerals. NINTH ANNUAL REPORT . . . FOR THE FISCAL YEAR ENDED MARCH 31ST 1958: Its Ann. Rept. 9, 64 p., 2 fold. maps, fold. chart, 1958.

Report contains statistics on mineral rights leased, on purchased Crown Reserves drilling rights, and on mineral production. Also included is information on mapping and mineral taxation--G. E. Denegar.

1-543. Rothrock, E. P., and Allen F. Agnew. THE BIENNIAL REPORT OF THE STATE GEOLOGIST FOR FISCAL YEARS 1957 AND 1958: South Dakota, State Geol. Survey, 48 p., 2 ports., map, 1958.

During fiscal year 1957, mapping and appraisal of the coal resources in NW. South Dakota were completed, geologic-quadrangle mapping in the White River area was initiated, contributions to the appraisal of the shallow water reservoirs in South Dakota were made, and subsurface data from oil-well tests collected. Brief accounts of these accomplishments are given. During the year, 14 maps, 6 reports of investigations, and one biennial report were published.

During fiscal year 1958, a program of detailed geologic mapping of glacial deposits in the Big Sioux River basin was initiated, geologic-quadrangle mapping was continued, work on a magnetic map of the State was carried out, and subsurface data from oil-well tests was collected. During the year, 15 maps and 2 reports of investigation were published. --G. E. Denegar.

1-544. Buckmaster, J. L., and A. H. Mears. INSTRUMENTAL IMPROVEMENTS IN ALTIMETRY: U. S. Geol. Survey, Circ. 405, 33 p., 21 figs., 1958.

Theoretical and practical considerations in designing altimeters are discussed, and experimental models that incorporate optical magnification instead of mechanical multiplying systems are described. An improved calibration standard, the barostat, is also described. --U. S. Geol. Survey.

1-545. Thorndike, E. M. DEEP-SEA CAMERAS OF THE LAMONT OBSERVATORY: Deep-Sea Research, v. 5, no. 3, p. 234-37, 4 figs., 1959, 6 refs.; also pub. as: Lamont Geol. Observatory, Contr. no. 320, 1958.

Deep-sea cameras now in use by the Lamont Geological Observatory consist of a standard optical system employing a 35 mm. focal-length lens and f/3.5 aperture, giving an angular field of view in water of 42° x 36°. An alternative optical system employs a wide-angle lens. Normally, the camera is loaded with 20 ft. or less of unperforated bulk film which is moved electrically after each exposure. Illumination is obtained by discharging two 525 μF. electrolytic condensers through an electronic flash tube. Details on switches, signalling system, and housing are also given. --G. E. Denegar.

1-546. Waggoner, Claude W. PHOTOGRAMMETRIC MAPPING OF HIGH BLUFFS: Civil Engineering, v. 28, no. 12, p. 73-75, 3 illus., Dec. 1958.

Due to physical and financial impracticalities necessitated by a field survey, first-order or high-precision plotting instruments were used in mapping barren basalt bluffs that wall the banks of the Columbia and Snake rivers, Washington. Various photogrammetric techniques were developed. A method of electronically transferring information obtained in this and like surveys from maps to punch tape or cards was devised. With the application of this technique, an estimated 50% saving in total cost of surveys and even greater savings in measuring earthwork quantities could be realized, as well as reduction in accidents to field personnel. --G. E. Denegar.

1-547. Lebedev, A. P. O SYEZDE MEZHDUNARODNOY ASSOTSIATSII VULKANOLOGII V G. TORONTO (KANADA) V SENTYABRE 1957 G. [THE CONGRESS OF THE INTERNATIONAL ASSOCIATION OF VOLCANOLOGY IN TORONTO (CANADA) IN SEPTEMBER 1957]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 2, p. 100-106, 2 tables.

This article is a report on the conference of the International Association of Volcanology which took place in Toronto (Canada) Sept. 3-14, 1057. The composition of the Soviet delegation was as follows: Professor B. I. Vlodavets, Director of the Volcanologic Laboratory of the Academy of Sciences of the USSR (head of the delegation); B. I. Piyp, S. I. Naboko, G. S. Gorshkov, V. G. Silnichenko - scientific collaborators of the Volcanologic Laboratory; V. S. Sobolev (petrology) and Ye. K. Lazarenko (mineralogy) members-correspondents of the Academy of Sciences of the UkrSSR; K. G. Shirinyan (volcanology) - scientific collaborator of the Institute of Geological Sciences of the Academy of Sciences of the Armenian SSR; and A. P. Lebedev (paleovolcanology, petrology) - scientific collaborator of the Institute of Geology of the Academy of Sciences of the USSR. G. S. Gorshkov was elected chairman of the section of volcano-physics of the association. --LC.

1-548. Nikiforova, K. V., and Ye. Shantser. V KONGRESS MEZHDUNARODNOY ASSOTSIATSII PO IZUCHENIYU CHETVERTICHNOGO PERIODA [THE 5TH CONGRESS OF THE INTERNATIONAL ASSOCIATION ON THE STUDY OF THE QUATERNARY PERIOD]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 5, p. 146-51.

Congress convened in Madrid Sept. 2-17, 1958. Representatives of 32 countries took part in it. The Soviet delegation was represented as follows: Academician K. I. Lukashev (AS BSSR) - head of the delegation; Academician V. G. Bondarchuk (AS UkrSSR); Ye. V. Shantser and K. V. Nikiforova (GIN AS USSR); I. I. Krasnov (VSEGEI); I. S. Rozhkov (Yakutia Branch of the AS USSR); K. K. Markov and A. K. Matveyev (MGU). --LC.

1-549. Wengerd, Sherman A. GUIDE TO THE PREPARATION AND DISPOSITION OF MANUSCRIPTS FOR PUBLICATION IN THE BULLETIN: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 1, p. 202-16, Jan. 1959, 11 refs.

Three important components for attainment of editorial excellence in the Bulletin are: the author, the editorial board, and the reader. With few exceptions, all are members of The American Association of Petroleum Geologists, dedicated primarily to the discovery and production of petroleum, and secondarily to the publication of a Bulletin which fairly represents their professional activities.

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Manuscripts submitted to the editorial board may take one of several routes devised to aid both the writer and the editors in reaching accord as to acceptability of the contribution for the benefit of the greatest number of readers. --Auth.

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